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ABSTRACT

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair. Fairs operate on a step basis. Students who win in small fairs such as a local fair, move to a city fair, then to a regional fair, and may be chosen to represent that fair in the International Science and Engineering Fair (ISEF). The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 34th ISEF in Albuquerque, New Mexico in May, 1983 as the result of being chosen the best in 560 affiliated fairs. Abstracts are organized by project categories. These 12 groups are described and include: behavioral and social sciences; biochemistry; botany; medicine and health; microbiology; zoology; environmental sciences; chemistry; earth and space sciences; engineering; mathematics and computers; and physics. An index is also included of all the finalists. (ML)

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ABSTRACTS

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34th International Science and Engineering Fair

Albuquerque, New Mexico

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ABSTRACTS

34th International Science and Engineering Fair

Abstracts of the Finalists

of the

International Science and Engineering Fair

held in

Albuquerque, New Mexico

May 9-14, 1983

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PREFACE

A science and engineering fair is a competition based on the quality of projects done by students, the results of which are reported through exhibits and oral presentations at the fair.

The purpose of fairs is threefold: to stimulate in young people an active interest in science and engineering; to provide an educational experience through being exposed to the judges and to the public; and to give public recognition to talented students for the work they have done.

Fairs range in scope from the local level, which may involve one class, or one district, to ones which may involve a large city, a county, a state, or even a nation. While there are no exact figures, it is estimated that over one million student projects are undertaken each year in the United States, and that there are fairs in more than twenty other different countries.

Science and engineering fairs operate on a step basis, with students who have won in small fairs participating in large fairs as representatives of the fairs in which they have previously won. Thus, an individual might participate in a local fair, move to a city fair, then to a regional fair, and be chosen there to represent that fair in the International Science and Engineering Fair.

The finalists whose project abstracts are reported in this book won the honor of presenting their projects at the 34th ISEF in Albuquerque, New Mexico in May 1983 as the result of being chosen the best in 560 affiliated fairs.

Science Service, the nonprofit institution devoted to the public understanding of science, which conducts the International Science and Engineering Fair, pays tribute to these finalists, to their teachers, and to the thousands of individuals and organizations who made possible the presence of these ISEF finalists in Albuquerque.

We wish to thank the General Motors Foundation for the funds which supported the printing of this book.

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BEHAVIORAL AND SOCIAL SCIENCES

# AUDITORY MEMORY: THE ART OF LISTENING. CAN IT BE ENHANCED BY RHYMES AND MUSIC?

Ash, Gwynne E., A&M Consolidated High School, College Station,
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1122 Westover, College Station, Texas 77840.

It has been said many times that listening is a lost art. Last year, in my experiment comparing visual and auditory short-term memory, I found that auditory skills were indeed lacking. I felt this was due to the little stress given to listening skills in the classroom.

This year I began my experiment on a group of gifted sixth graders. I chose this age to find a way to sharpen the younger students listening skills and teach them to organize their thoughts before they reach high school.

For the experiment I made three tapes, each with one version of a poem on it. I divided the class into three equal groups. To the first group (the control) the tape was played with a poem, inserting synonyms of equal difficulty for the rhyming words to make it a group of correlating non-rhyming sentences. The poem (on tape) was read in its original form to the second group. The third group listened to the poem set to a simple melody.

As I had expected, the poem set to music was the best remembered with 22 out of 33 words correct. The original poem was the second best with 21 out of 33 words remembered. With 15 out of 33 correct, the group of sentences was the worst remembered.

Perhaps teachers could use this information when they relate facts and figures to the children. This has already been used to some extent. After all, didn't we all learn our ABC's set to music?

#Honorable Mention - American Psychological Association

UNLOCKING THE SECRET "A 4.5 YEAR STUDY ON THE FEEDING BEHAVIOR OF THE CULEX PIPENS QUINQUEFASCIATUS MOSQUITOES."

Johary, Clara F., Union County High School, Lake Butler, FLA
32054; P.O. Box 278, Raiford, Florida 32083

UNLOCKING THE SECRET "A 4.5 YEAR STUDY ON THE FEEDING BEHAVIOR OF THE CULEX PIPENS QUINQUEFASCIATUS MOSQUITOES."

The purpose for this particular project, is to gather more information due to what really attracts the mosquitoes to humans. So that it may help find a way to let the mosquitoes reproductive system be sterilized. It will help towards decreasing (controlling) the rate of populations of these mosquitoes and its diseases.

Problem - Are feeding behavior of the Culex pipens quinquefasciatus mosquitoes affected by any of the following: minerals, color hormones, urea, AB & O plasma and sera.

I hypothesized that factors in human blood and chemicals in human sweat may affect the chemical receptor of mosquitoes as evidenced by feeding preferences.

Procedure - A test box was constructed so that dishes of these materials and the mosquitoes could be introduced and observed. The mosquitoes were raised from larvae. The doctor supplied me with testing material. Trials were conducted in the following manner as stated in my problem, using twenty females for each test. A record was kept on how many mosquitoes were and were not feeding.

Conclusion - From the twenty tests consisting of twenty-eight recordings, I can postulate that under all conditions, mosquitoes preferred; 1) Male AB blood type; 2) AB & O serums; 3) Centrifuged O seri,s' 4) Urea in water.

Feeding stations of sera with mosquito insecticides could be used to reduce the populations in a mosquito infested area.

BIRTH ORDER, I.Q., AND LEARNING PROBLEMS

Weiss, Douglas L.P., Citrus High School,
Inverness, FL. 32650
1560 S. Hillock Terrace, Inverness, FL. 32650

This project tests the relationship between birth order, intelligence, and learning problems. It was suggested by research in this field by R.B. Zajonc, who developed the confluence model to explain the drop in intelligence among consecutive siblings. This construct holds that each additional child tends to lower the total intellectual environment. In addition, it holds that children sharpen their knowledge by teaching younger siblings. The present research was designed to determine if the intelligence-birth order relationship noted by Zajonc holds true in children having learning problems.

Permission was obtained to gather anonymous data about 100 children having learning problems. These subjects were randomly drawn from a group of 1400 students in a Central Florida school district. Birth order and intelligence information was obtained regarding each of the students, who were identified only by a random case number. The information was sorted into groups for first born, only, last born, and other. An Analysis of Variance test was performed on the IQ scores of these groups.

The results showed that of students having learning problems, there is nearly a ten point difference in intelligence scores of first born compared to last born and only children. This was found to be statistically significant at the .05 level. One possible implication is that it might prove beneficial to provide opportunities for students having learning problems to teach simpler skills and concepts to younger children. According to the confluence model, this should help sharpen their own knowledge and abilities.

#POSSIBLE RELATIONSHIPS BETWEEN THE HANDLING OF EMOTIONAL TRAUMAS AND THE START OF THE CANCER PROCESS

Adam, Laurie M., Okeene H.S., Okeene, OK 73763
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The purpose of this study is to further research emotional traumas possible relationship with cancerous disease.

Through my conclusions last year and the results from a relating medical study I learned of the possible link between traumas and cancer. This research took under consideration the feelings felt by both a cancerous and a control group after the occurance of an emotional trauma and its possible link with this subject.

This project was conducted by questionnaire, the cancerous questionnaires were filled out by sixteen cancerous trauma sufferers and the control questionnaires were filled out by sixteen non-cancerous trauma sufferers.

The main traumas suffered where death or illness of a spouse or family member and divorce.

In summed up conclusions my research showed that 68.75% more negative emotions resulted in the cancerous group than in the control group after the occurance of an emotional trauma.

Now I am not stating that emotional traumas handling is the only cause of cancer. Instead my research shows that this subject is to important to ignore. And perhaps it is very possible that certain people may not be affected by negative emotions in a strong enough way.

From my results I feel that negative emotions resulting from the occurance of an emotional trauma could trigger the start of the cancer process.

#Fourth Award - General Motors ISEF

#INTERRELATIONSHIP BETWEEN CREATIVITY, VISUAL PERCEPTION, AND CEREBRAL PREFERENCE

Krishnamurthy, Meera, Muskogee H.S., Muskogee, OK 74401
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The three phases of this research project were designed to analyze components of the process of creative thinking. A study to determine involvement between the two hemispheres of the brain during creative thinking was developed using creativity tests designed by Rothenberg, Raudsepp, Rorschach, and Guilford (Phase I). Results of this study caused the researcher to examine the concept that perhaps a correlation existed between the creative hemisphere and the dominant hemisphere (Phase II). For further analysis of the components of the process of creative thinking, the possibility that a correlation existed between levels of creativity and visual perception while assessing cerebral preference was examined in this phase of the research project.

The Torrance Tests of Creative Thinking (Figural Form B) was used to assess two factors of creativity -- elaboration and originality. The Holtzman Inkblot Technique was used to evaluate factors of visual perception -- reaction time, number of rejections, space (figure-ground reversals), movement, color, and location. An internal visualization factor was also analyzed from the Torrance Tests.

For an assessment of cerebral preference, a computerized hemispheric dominance test was used. This program was designed by this researcher and employs tachistoscopic techniques and self-evaluation questions.

These tests were administered to right and left-handed subjects of various age groups. Results suggested there is a correlation between levels of creativity and specific factors of visual perception.

#First Award - American Speech-Language-Hearing Association
Meritorious Award - United States Army
Honorable Mention - Auxiliary to the American Optometric Association

A BEHAVIORAL STUDY OF THE ANT-LION MYRMELEON INSERTUS (HAGEN) IN SOUTHWESTERN PUERTO RICO

Ruiz, Joelly V., Lola R. de Tio, H.S., San Germán, P. R.;
Urb. Porta Coeli A-21, San Germán, P.R . 00753.

This investigation involves a detailed study of the ant-lion Myrmeleon insertus of the family Myrmelionidae. Major emphasis has been placed on ecological, biochemical and behavioral aspects.

Populations of this ant-lion show a clumped pattern of distribution. Density varies according to size of the same. Some populations can be measured per foot square while others can not. An attempt was made to determine the average size of ant-lion pits per station. Pits were measured as to diameter, angle of inclination and height. Measurements were used to determine volume and area of pit. Behavior of pit construction under light or darkness was studied.

Fifty ant-lions were collected from each station. Twenty five were used for larval measurements: length, width, diameter of mandibles as well as weight. Twenty five were used for behavioral tests. We have shown that searching prey capacity and size range can be measured by taking the diameter of the pit, the nutritional history, prey size distribution and abundance by collecting carcases around rim of pit as well as competitive effect of neighbors, in percent prey intercepted and by the spatial distribution of ant-lion larva of various sizes and on the diameter of their pits.

Prey capture and competition are simple to measure in larval ant lion. There is a big difference in food availability between the largest and smallest individuals. Larva grows to optimal size as food getter, but no larger before metamorphosing. A special distribution of ant lions minimizing competition was observed.

RETENTION OF AURAL MESSAGES AND INFLUENTIAL SCHOOL RELATED WORK VALUES

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In this study, the retention of favorable and unfavorable aural messages was compared to determine if subject matter influenced retention and which school related work values correlated with this retention of aural messages.

Favorable and unfavorable messages were determined by having each auditor rate 10 preselected topics according to interest. Prerecorded paragraphs with subject matter pertaining to each topic were used as the aural messages. Auditors listened to a favorable and an unfavorable aural message and responded to three literal recall questions. Reponses were checked for accuracy. Auditors then responded to a School Related Work Values Survey that determined which of the eleven values influenced retention.

Results indicated no more than one incorrect response was given by 100% of the auditors for the favorable aural message questions compared to only 48% of the auditors for the unfavorable aural message questions. These results divided the surveys into two distinct groups in order to compare the relative scores of values. Relative scores were 7.2% higher in the High Correct Response Group (HCR) than in the Low Correct Response Group (LCR).

Four values in the (HCR) group that differed significantly with the (LCR) group were altruism ($p<0.05$), achievement ($p<0.01$), creativity ($p<0.01$) and intellectual stimulation ($p<0.01$).

It was concluded that auditors listen more effectively when presented a favorable aural message. Individuals also retained aural messages more effectively if the individual auditor considered certain values to be of greater importance than other values.

A STUDY OF MEMORY IN CLASSICALLY CONDITIONED PLANARIA (*DUGESIA TIGRINA*)

Minyard, William P., Starkville High School, Starkville, MS 39759;
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This research is directed towards establishing a model for planarian behavior which can be applied to vertebrate research. Project objectives are: (1) to determine if savings (quicker learning during retraining) and direct recall (increased response rate after training) are actually two different memories psychologically; (2) to determine if these two memories are biochemically different by feeding RNA and protein extracts from trained to untrained planaria to transfer each memory system; and (3) to make inferences about memory mechanisms from transfer experiments.

Training procedure involves three seconds of light paired with electric shock in the final second. Worms contract to shock, but not to light. A correct conditioned response is contraction of head or body during first two seconds of light.

This work demonstrates that savings memory is not affected by extinction (presentation of light alone repeatedly until direct recall memory is eliminated), even when extinction trials on consecutive days prevent any spontaneous recovery of direct recall memory. Direct recall memory is transferred in a protein fraction of 10,000-30,000 daltons; savings memory is not. Memory of extinction transfers in a protein fraction of 30,000+ daltons.

Savings and direct recall are, therefore, two psychologically and physiologically independent memory systems. Because they have been found in such a low level invertebrate, they are probably integral parts of memory and behavior in higher level animals. Results of this work can be used to explore physiological mechanisms for fundamental behavior in vertebrates.

THE EFFECT OF ENVIRONMENTAL CONDITIONS ON DROSOPHILA COLOR PREFERENCES

Kudla, Robert J., Fitzgerald H.S., Warren, MI 48091
21487 Curie, Warren, Michigan 48091

Insects are noticeably attracted to particular flowers in a garden or field. Since color is a selective factor, it was the purpose of this study to determine if Drosophila color preference was inherited or conditioned by the environment.

Wild-type and white-eyed Drosophila were cultured and raised in vials of different colors consisting of neutral, red, yellow, blue, green, and orange. An experimental chamber was constructed in which 25 miniature lights could be altered in illumination and be covered by surfaces of the five different colors. All experiments were carefully controlled so that any possible geotropic or phototactic response would be the same within the trials. One vial of Drosophila was introduced into the chamber at a time and the number of flies making a selection was noted every five minutes for a total of ten trials per experiment. The color sets were rotated clockwise to make sure the Drosophila were not selecting a color because of position. Therefore, each vial of flies was examined during five color sets of ten trials each. Data was recorded as percent of flies making a color selection within a trial, and the probability of chance was examined by Chi-square analysis.

Drosophila bred and raised in a monochromatic environment avoided the color in which they were raised. White-eyed Drosophila preferred blue and orange over wild-type Drosophila when both were tested in the same light conditions. From the data on wild-type Drosophila tested in dim and bright lights, it was concluded the brighter the light the darker the color chosen. Because of the significant relationship between environmental condition and colorpreference, it may be concluded that the color selectivity behavior of Drosophila is a learned phenomena.

EARLY MOUSEHOOD EDUCATION

Beacham, Annette, Briarwood School, Palatka, FL 32077;
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The purpose of this project is to determine if a stimulating environment in early stages of growth affect the learning rate of *Mus musculus*.

The first step was to obtain 3 mice of approximate age, coloring and background. Secondly, each mouse was placed in a seperate chamber. Chamber #1 was made barren except for bedding, water receptical and food. This cage was the control. Chamber #2 was made like #1 except for the addition of an exercise wheel. Chamber #3 was made like #1 except for the following: an exercise wheel, a plastic log, a see-saw and blocks of various shapes, colors and sizes which are continually rearranged. Food for the mice consisted of one tbsp. of wild bird seed and several pieces of bread daily.

After the mice had inhabited their environments for 3 weeks, their short term learning was tested by running the mice through several different mazes in 5 different experiments. An incentive of bread was used. In experiment #1 the incentive was placed in the same area of the maze while testing for 9 days. In experiment #2 the same maze used in #1 was used for testing and the bread was placedin different areas of the maze for 9 days. In experiment #3 the mice were tested in a different maze for 5 days and the incentive was placed in the same area. In experiment #4 the mice were tested in the same maze used in #s 1and 2 for 5 days and the incentive was placed in the same area; this tested longterm learning because there were several weeks between the testing of experiments #3 and #4. In experiment #5 the mice were tested in a totally new maze for 5 days and the incentive was placed in the same area. Expriments #1,2,3 & 5 determined short term learning. The mice were timed on a stopwatch. In all of the tests performed,mouse #3,the stimulated one, had the best avg.

DOES THE WIDTH OF A FISH AFFECT ITS BALANCE?

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The purpose of this experiment was to determine whether the lateral compression of a fish affects the amount of instinct that the fish must rely upon for equilibrium. Using my own original apparatus and method, I tested nearly sixty species of tropical and non-tropical fish to determine how they would react to unusual angles of light presentation. After studying the trends I found in my preliminary testing, I decided to focus my experimentation on how the width of a fish affects its balance. I chose four species of tropical fish which were representative of different widths and families. I then preceeded to run fourty-eight on each of the species; eight tests on six different specimens of each. To formulate the results of my testing, I utilized my own theory that during the first five minutes in light, a fish depends fifty percent on its instincts, which tell it that light is "up", and fifty percent on its gravity-sensitive organ, the otolith, for equilibrium while swimming. My work showed that those fish tested which were least in width were dependent upon their instincts to a much greater degree than their more corpulent counterparts, which were more reliant on gravity for their balance.

#Fourth Award - General Motors ISEF

TEST VEHICLE TO EVALUATE CURRENT ISSUES

Spring, Kevin B., Mayfield H.S., Mayfield, OH 44143
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The development of a test vehicle to evaluate current issues based on the responses of senior citizens and high school students to a series of yes/no and rank order questions is described. Averaging and weight averaging of the responses was used to determine trends and compare the opinions and interests of the students to those of the adults. Results are interpreted in light of the socio-economic and cultural background of the respondent groups.

#CAUSES OF THE VON RESTORFF EFFECT

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This experiment evaluated two possible explanations for the occurrence of the von Restorff effect in a serial word list. The amount of time spent studying an isolated word and the frequency of usage of that word will directly affect the retention of the word. The method consisted of designing four different serial word lists which the subjects were instructed to study. The subjects were allowed to spend as much time as they wanted studying each word; this process was facilitated by use of a computer. The raw data was then collected and analyzed through statistical computations. The concluding points of significance demonstrate that the "local context" concept and the amount of time spent studying a word directly affect the retention of a given word. Another possible explanation was a motivation/challenge factor.

#Second Award - General Motors ISEF
Honorable Mention - American Speech-Language-Hearing Association

# RADIATION: HOW MUCH IS TOO MUCH?

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Large amounts of radiation have caused physical damage to exposed subjects. Could X-irradiation also have a detrimental effect in very small doses, similar to those given off by cathode ray Video display terminals? Doses of X-ray that apparently don't cause any physical damage could have a behavioral effect. This experiment will test the behavioral effects in both the offspring and the mothers when they are exposed to different levels of radiation during the gestation period.

Thirty-two pregnant Balb-C mice were divided into 4 groups. Group 1 was control. Group 2 was exposed to 10R of X-irradiation on day of gestation. Group 3 was exposed to 80R and Group 4 to 150R. A GE Max-i-max X-ray machine was used for exposure.

The mothers and their offspring were tested in a shuttle avoidance task. The number of escapes, avoidances, and latency times were recorded and Analyzed. The adult weights of the offspring (a total of 169 mice) were also recorded.

The data were analyzed using a 2x4 factorial analysis of variance. A post hoc analysis was also conducted.

The results show that radiation has a detrimental effect on the learning ability of the offspring. This was significant at the .005 level. The learning ability of the mothers wasn't affected by the radiation. The high level radiation group had fewer mothers give birth, which would imply more miscarriages.

Further research on the effects of smaller radiation doses accumulated over time, second generation effects, and tissue analysis to determine the exact effect of the radiation is possible.

#First Award - American Psychological Association
First Award - United States Army
Fourth Award - General Motors ISEF
Merit Award - American Medical Association

#COMPARATIVE EFFECTS OF ATHROPINE, SCOPOLAMINE AND DATURA: CARDIOVASCULAR STUDIES IN TOADS AND BEHAVIORAL STUDIES IN CATS.

Zayas, Felix S., Dr. Pila High School, Ponce, P.R., 00731:
16-O-9 Alta Vista, Ponce, P. R. 00731.

Datura has two important alkaloids: atropine and scopolamine. The objective was to compare the effects of atropine, scopolamine and Datura in cardiovascular studies in toads and behavioral studies in cats. Infusions of dried leaves were made at different concentrations. Atropine and scopolamine were prepared at an equivalent concentration as appears in the Datura leaves. Cats were tested before and after injections (1cc/kg i.p.) of Datura infusions and alkaloids. The occurrence of 13 behaviors, neurological signs, staring and locomotion time were scored at 1,2,3,4 and 24 hours post injection. The toad heart was exposed and the ventricle was hooked to a string connected to a transducer. Each mechanical contraction and the ventricle force were recorded by a polygraph. Injections were made at 0.5 cc/kg i.m. and i.c.. Infusions (20%) increased the amount of sleep and decreased the staring and locomotion time, grooming and feeding for over 24 hours, in cats. Atropine decreased the sleep, grooming and staring time. The locomotion was decreased for over 24 hrs.. Scopolamine increased the starring time and decreased the locomotion time, feeding and grooming. The heart rate was decreased by the alkaloids and increased by Datura. Each increased the ventriculat force. These results show that atropine and scopolamine are not responsible for the observed actions of Datura leaves.

#Third Award - General Motors ISEF

#THE BEHAVIORAL EFFECTS OF OPIATE AGONISTS AND ANTAGONISTS IN THE PIGEON

Schafer, Jon Thomas, Ann Arbor Pioneer High School, Ann Arbor, Michigan 48103; 622 Center Dr., Ann Arbor, Michigan 48103

This study investigates the interactions between two agonists, morphine and pentobarbital, and the narcotic antagonists naltrexone, naloxone, Mr2266, and diprenorphine. Pigeons were trained to respond on a single key for a fixed-ratio 20 schedule of food presentation. Sessions were held every day, with testing on every 5th or 6th day. All injections were administered intra-muscularly, and all drugs were given using cumulative dosing. Narcotic antagonists were tested alone and as pretreatments to cumulative doses of morphine or pentobarbital. Morphine and pentobarbital caused total rate suppression at doses of 10.0 and 17.8 mg/kg, respectively. All of the antagonists displayed dose-dependent antagonism of morphine, with most of the drugs reaching a maximum effective antagonist dose (i.e., increasing the antagonist dose failed to provide further antagonism). Naltrexone, naloxone and Mr 2266 were approximately equipotent in antagonizing morphine, even though each, when given alone in high doses, suppressed rates at different doses. Diprenorphine suppressed rates at the same dose as naloxone (56.0 mg/kg). Diprenorphine was unique in that 1.0 mg/kg given as a pretreatment antagonized a cumulative dose of 32.0 mg/kg morphine. When given alone, the doses of each antagonist needed for rate suppression were 300-500 times greater then the dosed needed to antagonize morphine. Naltrexone, naloxone, Mr 2266, and diprenorphine are specific opiate antagonists, in that none were effective against the rate reducing effects of the non-opiate pentobarbital. By comparing potencies and actions, this study demonstrates the specificity and behavioral interactions between morphine and several opiate antagonists.

#Honorable Mention - American Psychological Association

#INVESTIGATION OF ENDORPHINS, OPIATE ANTAGONISTS, AND FOOD INTAKE IN MICE

Rothman, Edie K., Upper Dublin H.S., Fort Washington, PA 19034;
1605 Kenmare Drive, Dresher, PA 19025

Recent studies indicate endorphins (endogenous opiates) play a role in appetite behavior. Endorphins have already been linked to runners high and other stress-reward type situations. The researcher investigated how a stress-induced flow of endorphins affected food intake.

Mature female mice were deprived of food 22 1/2 hours per day and fed 1 1/2 hours per day. The stressor utilized was a series of cutaneous foot shocks.

A general trend toward reduction in food intake over a period of days was observed. Mice that received foot shock before feeding did not exhibit this decrease in food intake, however when naltrexone, a pure opiate antagonist, was administered after the shock program, food intake decreased significantly.

This data supports the possibility that endorphins may induce feeding through a central "reward" system in the brain which can be blocked by opiate antagonists.

This research is important because it suggests a biochemical mechanism for a problem (obesity) that was previously treated as a psychological disorder in all but the most extreme cases. Our society views chronic over-eaters and people with dietary disorders (bulimia, anorexia nervosa) as maladjusted at best and mentally ill at worst. It is possible that these individuals are victims of a biochemical imbalance which may in the future be treated safely and effectively with opiate antagonists.

#Honorable Mention - American Psychological Association

#POST-ABSORPTION: A TWO YEAR EXPERIMENTATION OF THE ARSIS EFFECTING THE TRANSFORMATION OF THE METABOLIC PROCESSES WITHIN HOMO SAPIENS AND MUS MUSCULUS'.

Stanton, Deborah K., Spruce Creek High School, Port Orange, Fl., 32019
P.O. Box 4154, S. Daytona, Fl., 32021 (MAILING)

The title of this project is; Post-Absorption: A Two Year Experiment Of The Arsis Effecting The Transformation Of The Metabolic Processes Within Homo Sapiens and Mus Musculus'. The procedure was performed in three experiments. The first of which was to restrict the dietary intake of three human subjects. The tenure of this experiment was 5 days,after which a urinalysis was taken to recognize any by-products.

Second,fourteen mice represented a control group and fourteen others were placed on a protein restricted diet for 2 weeks. The completion of two weeks was followed by the extraction of 1/2cc. of peripheral blood . Blood smears and further tests with the Coulter counter were performed. A bone marrow specimen was obtained from the right femur.

The final experimentation involved the injection of DHLP Parvo into the blood stream, to observe any hyperactivity as a result. Results are as follows: all diets tested exhibited a weight reduction therefore producing ketones as an end product of gluconeogenesis. The lymphocyte count was significantly higher in the nutritionally adequate as formulated before experimentation. A difference of 2,407 cells were calculated, as the normal differing within the two groups. The nutritionally adequate mice injected reacted to all amounts administered, and more hyperactivity was rapidly present as the portions increased, yet no reaction was observed in the mal-nutritioned within 8 hours.

The conclusions were that the diets forcing fat catabolism, which in this case were all, produced ketones, which can, if an accumulation develops lead to a diabetic coma or death. The lymphocyte reduction decreased the body's resistence, therefore leadind to hypercativity.

#Fourth Award - General Motors ISEF

DOES AGE AFFECT MAN'S RESPONSE TO A LIGHT STIMULUS?

Gonzalez, Monica, Rio Grande City H.S., Rio Grande City, TX 78582; 510A Lincoln St., Rio Grande City, TX 78582.

The purpose of this project was to find out if age affects man's response to a light stimulus by testing five different age groups to see which was more accurate at reading a syllable in a dark room when flashed light for about 1/3 of a second.

The materials needed: 60 people (5 different age groups), 7 cards (each with one syllable written on it), 1 card holder, 1 flashlight, 60 answer sheets, 1 dark room, 1 person testing people, 1 pen/pencil.

The procedures were: 1. Told person what experiment was about. 2. We went into pitch dark room. 3. Gave him/her answer sheet. 4. Started testing (flashed light for about 1/3 of a second). 5. He/She wrote what they saw. 6. Tested him/her ten times. 7. Did this process twice to each person. 8. Tallied up total number of errors for each person. 9. Tested 60 people (5 different age groups).

The results were: the Youth Group was the most accurate group. The second most accurate group was the Childhood Group. The Adulthood Group was third, the Middle Age Group was fourth, and the least accurate group was the Old Age Group.

The conclusion of this project was that age does affect man's response to a light stimulus. The reason for this was that as a person gets older, he/she becomes slower at responding to a light stimulus.

FIELD-DEPENDENT AND FIELD-INDEPENDENT STUDIES ON THE ELEMENTARY AGE CHILD

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My project is based on Synectics, the science dealing with the study of the different characteristics between left, right and center brained people, with center considered the ideal. Left brained people are field-independent, don't have many people skills, love numbers, prioritize well and they know the answers. Right brained people are field-dependent, have many people skills, don't like numbers, cannot priortize well, but have ideas. Center brained people have characteristics of both. A center brained person is a better overall thinker and functions well in society. To date, all experiments on this subject have been done on and adult and teenage level. I felt that synectics could also benefit children, as most of them should be right brained. To this end I have pioneered this research.

Using the Embedded-Figures Test, I tested elementary school students. I found that as a group they did not have the attention span needed to concentrate on the test. I started working with the children one on one. After completing tests, I gave some of the students exercises to stimulate and develop the side of the brain they used least. After weeks of exercises, I tested all the students again. My experiments show that all the children tested were extremely right brained. This indicates that children in the early grades of school have little or no cognitive skills, and are extremely field-dependent. I also found that if given synectic exercises, and if worked with on an individual basis, they did show a notable improvement on the Embedded-Figures Test.

#THE SIZE AND EFFECTS OF INVASION OF PERSONAL SPACE

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Personal space is defined as the area which individuals would like to have between themselves and others. In areas of high population density such as schools, this personal space is often invaded by others, and this invasion may cause some of the emotional and behavioral problems that arise in schools. The purpose of this experiment is to study the size and shape of adolescent personal space and to compare it with that of adults.

Phase I of the experiment was a study of normal spatial behavior of adolescents in which 50 pairs of adolescents were observed and the behavior and distance between each member of the couple was noted.

In phase II the investigator located a subject seated alone at a table and seated himself close to the subject. Observations were made, and the subject was told of the experiment and asked to rate reactions of hostility, fear, nervousness, and intimidation.

Phase III was comprised of a survey called the Comfortable Interpersonal Distance Scale and was completed by 70 subjects. The survey is in the form of eight lines radiating from a central core, and subjects were told to mark on the lines how close they would allow imagined approaching persons to get.

From this research it was determined that there are many factors influencing personal space, and that personal space differs both between adolescents and adults and by sex. Also, many reactions are incurred by invasion of personal space, and these may be intense.

#Second Award - General Motors ISEF

# THE EFFECTIVENESS OF AN ACCELERATED EDUCATION

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The purpose of this project was to determine more efficient ways of educating a child. My hypothesis consisted of this basic principle: Students could increase their learning capacity when subjected to more accelerated programs at an earlier age.

The subjects used for supporting the hypothesis ranged from six to nine year children who were attending grades one through three. The testing groups were divided into a "controlled" and "uncontrolled" class for each grade. The "controlled" groups were those receiving the accelerated programs; the "uncontrolled" groups were those classes which merely pursued the curriculum of previous years. The children of both groups were tested three times during week 1, week 6, and week 12 of the experiment. The results of each test were recorded and finally composed a graph of success. The results from each grade concurred a measurable increase of performance in both given groups; reading comprehension and math. Careful records were kept throughout the experiment as to ensure precision and accurate results.

The experiment was extremely successful due to the superiority exemplified by the accelerated group. This "controlled" group far surpassed that of the old manner. Each child involved in this program (on the controlled side) illustrated success. It could be concluded that such a program administrated on a larger, more extensive level, could benefit the young children of today- for they are our future of tommorrow.

#Second Award - American Psychological Association

HEMISPHERIC DOMINANCE WITHIN THE HUMAN BRAIN: THE RELATIONSHIP TO COMPATIBILITY

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Purpose: Thirty subjects were tested to determine the relationship between hemispheric dominance and compatibility. Procedure: Hemispheric dominance was determined utilizing the CLEM (Conjugated Lateralized Eye Movement)method. After listening to a brief monologue delivered by three individuals (panel members) representing the three cerebral conditions, the test subjects were asked to choose and describe the individuals with which they felt most compatible. Two trials were run with the field of vision varied. Also, a different set of panel members was used for each trial; the subjects remained the same. Results: The field of vision that the panel members were in did not affect the results. Less than one-fifth of the subjects (17% chose panel members who had the same cerebral dominance in both trials. Since the results from a single trial were based on only a few persons, the results of both trials were averaged to provide a larger sample size that would add more reliability to the results. More than half of the persons with a dominant hemisphere chose panel members of the same dominance (54.5% for subjects with a dominant left hemisphere and 57.5% with a dominant right hemisphere). Only one-fourth (25%) of the subjects with balanced hemispheric conditions chose similar panel members. The personal traits spontaneously given by the subjects describing the panel members with which they felt most compatible were friendly (60%), humorous (50%), self-assurance (47%), and frankness (30%). Conclusion/Application: Persons with a cerebral dominance feel compatible with persons of the same dominance. Results regarding persons with balanced hemisphere is not conclusive. This study can be utilized by complementary learning and teaching styles.

#THE CAPACITY OF PLANARIA TO BE CONDITIONED TO STIMULI: EFFECTS OF REGENERATION AND ORIGINAL TISSUE (A THIRD YEAR STUDY)

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Purpose: The purpose of my experimentation was to study the effects of regeneration and the role of original tissue from the first generation on the conditioning capacity of planaria.

Procedure: Extreme caution was taken in handling and feeding and the planaria were kept in darkness at all times. I chose nine healthier planaria and repeated the light/shock treatment (five seconds of light, three seconds of darkness, an instantaneous shock, and three seconds of darkness) 50 times on three planaria. Three hours later the treatments were repeated. When the planaria contracted in response to the light, the shock was omitted. A five second interval followed. The planaria were cut and the treatments were repeated on the six regenerated planaria a week later. The planaria were cut again and the treatments were repeated on the twelve regenerated planaria a week later. The treatments were repeated on the remaining six planaria again three hours later and a week later.

Results: All planaria responded to the light by stretching out and the shock by contracting in the first trial. I observed contractions in response to the light in the second trial of both samples; the trial in the second and third generation; and in the unregenerated sample(a week after first trial). These contractions became more defined, quicker and similar to those observed in response to the light in the first trial. There were a few scattered interruptions of stretching in response to the light.

Conclusions: I conclude that the planaria's capacity to be conditioned to stimuli is not significantly affected by the regeneration process and that original tissue from the first generation is vital to the conditioning process.

#Fourth Award - General Motors ISEF

#HOSPITALIZED CHILD-PARENT STRESS AND SLEEP ONSET LATENCY

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The purpose of this project is to confirm support system patterns for establishing a link between home and the hospitalized child. The researcher, in the child's dimly lit room, will record the behavior patterns of the subject during the sleep onset latency period, the time just before the subject falls asleep. The SSR System 7, an alpha - numeric keyboard which accepts pre-determined codes, will be used in this study to encode the behaviors. A wristactigraph, an instrument used to discriminate between the measures sleep and wake, will be worn around the subject's wrist to record all motility of the subject. The data, which is phase encoded onto a cassette tape by the two devices, is then transcribed by a high-speed computer for analyzation.

Twenty subjects, between the ages of three and nine, were observed seperately for three consecutive nights. Their behavior patterns, motility ratings, and duration of the sleep onset latency periods were recorded. Statistical analysis of the data confirmed the sleep onset latency period in the hospital to be almost twice as long as in the home. It also indicated a considerable increase in the motility of the subjects as compared to the control group. After careful and thorough analyzation, it was determined that the process of hospitalization does produce stress independent of that precipitated by the illness itself. Hopefully, new experiments can be performed to find a very effective method which will alleviate this stress.

#Third Award - General Motors ISEF

#THE EFFECT COLORED LIGHT HAS ON THE ACTIVITY AND WEIGHT GAIN OF THE MUS MUSCULUS ALBINA

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This experiment was initiated to examine whether different colors of light affect the activity level and weight gain of the Mus Musculus Albina. Each of five boxes was lighted by different color of 25 watt bulb: blue, green, yellow, red, and incandescent white. Twice, five Mus Musculus Albina from the same litter and very near the same initial weight were each eventually rotated into the various lights. A description of the activities of the mice was recorded hourly from 8 a.m. to 3 p.m. five days a week, and the mice were weighed thrice weekly over a 15 week period. Initially, the box temperature was recorded hourly to check constancy. In order to allow day-night studies, a timing mechanism was installed to the set of lights,and lighting time periods were varied as part of the experiment.Conclusive evidence concerningactivity level was not gained from the experiment, but the final results did indicate what weight gain was affected proportionately to the wave length of the colored light: the lower the wave length, the higher the weight gain of the Mus Musculus Albina; incandescent white light produced the least weight gain.

#First Award - American Veterinary Medical Association

#NOTES ON THE BEHAVIOR OF THE SHRIMP TULEARIOCARIS NEGLECTA (CHACE) 1969 (DECAPODA, PALEMONIDAE, PONTONIINAE): A SYMBIONT OF THE ECHINOID DIADEMA ANTILLARUM (PHILLIPPI) IN PUERTORICAN WATERS.

García, José A., Blanca Malaret High School, Sabana Grande, P.R.00747;
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This study represents an attempt to describe the symbiotic association between the echinoid Diadema antillarum (Phillippi) and the shrimp Tuleariocaris neglecta (Chace) 1969 in the shallow waters of Puerto Rico and to ellucidate the mechanisms underlining this relationship. Five hundred and fifty urchins were collected with one hundred and twenty one shrimps from seven stations. Host specificity trials were conducted to test the preference of the shrimp towards its natural host, five other echinoids, nine color facsimiles, a coral and a rock. Tuleariocaris neglecta preferred D. antillarum over all other urchins with 100% of preference in an average time of 0.16 seconds. This was followed closely by Echinometra lucunter with 99% in 0.34 seconds, E. viridis with 99% in 0.38 seconds and Eucidaris tribuloides with 98% in 0.56 seconds. The brown facsimile followed with 73% but in a time of 2.13 minutes. The shrimp rejected the other facsimiles, the coral and the rock. Tests conducted to find out if the shrimp locates its host in its natural environment using visual cues indicate that the shrimp appears to be attracted to the echinoid by visual recognition and that distance is an important factor. Further testing showed a preference of the shrimp for a dark environment over a lighted one. It has been observed that defense seems to be an important behavioral trait of this association. Tests conducted to see if the angle of vision is an important factor in the location of the host failed to confirm this. Tests conducted to determine if olfaction plays an important part in the location of the host by the shrimp showed that apparently it does not.

Observations on the behavior of the shrimp were carried out as well as test on spine preferences.

#Third Award - Marine Technology Society/U.S. Naval Institute
Honorable Mention - Eastman Kodak Company

BEHAVIOR AS RELATED TO STRESS AND VIDEO GAMES

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2015 Beech Street, Texarkana, AR 75502

The purpose of this project was to test the effects of stress on people while playing video games.

I began by preparing a stress test to determine the Type A and B behaviors of stress. After preparing this test, I selected fifty subjects from the ages 15-18 and had them take this test. Then I had them play three games of Atari's Asteroids, taking their pulse and blood pressure before and after each.

By observation, I found that the Type A personalities usually got more involved in the game and strived to win. The Type B personalities just played for fun and not necessarily to win. I also found that 70% of the people tested were under greater stress while playing the games. The other 30% were under little stress, if any at all.

Thus, in writing my conclusions, I have proved that video games cause stress in both Type A and B personalities.

DOES THE INCREASE OF RNA EFFECT THE INTELLIGENCE OF MICE?

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The effect of the increase of RNA in mice; study was made where there were three groups; group 1, control; group 2, on regular diet; and group 3, on yeast suppliment diet. By running mice through a maze, I found that the mice in group 3 showed more intellignece than the other mice. (Instincual behavior would be considered.)

THE EFFECT OF HARD ROCK MUSIC ON GERBILS IN A MAZE

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Throughout history, music has been siad to hold a certain power. Recently, many have inquired into the effects music such as hard rock may have on learning ability. This study was designed to investigate whether or not music has any such influence.

One gauge of animal learning ability is a rodent's ability to run a maze. In this experiment, gerbils ran a maze, both with and without music. Data was collected and stored in a computer, and later anlayzed using a student t-test. It was discovered that the difference in the number of errors made and the amount of time taken to complete the maze without music and the sam maze, inverted and accompanied by music of the hard rock genre, was too insignificant to establish that any relationship exists between this kind of music and an animal's actions.

THE EFFECTS OF VIBRATIONAL WAVES ON THE PLATY

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The Purpose of this project is to determine; 1) the frequency range to which the fish will respond,2) how the fish respond and adapt to different frequencies,3) how the fish respond to different types of music, and 4) to gain data on the behavior of the platy for coralation with data from a future Space Shuttle project.

The Procedure consists of six phases to determine; 1) the optimum control conditions,2) the frequency range producing a visually observable response in the fish,3) the effects of various frequencies,4) the adaptation time neccesary for various frequencies,5) the effects of frequently encountered noises,and 6) the effects of different types of music.

The basic Observations were that the fish; 1) have a ideal condition when in a controlled environment,2) have a range of frequency to which they respond,3) have a definite pattern of response to different frequencies,4) have a definite pattern of adaptation time for various frequencies in a inveraly proportional form,and 5) react to different types of music in various ways depending apon the rhythem and amplitude of the beat and the lower frequencies involved.

The over-all Conclusion is; A) that the fish do"hear"sound in the water and have definite patterns of reaction and adaptation to different frequencies,and B) that the platy has certain behavioral and physiological traits and patterns that are both observable and predictable, for use in analysis of future data.

This project has many Applications, for use in keeping the fish in their best top condition,for use in determining the possible effects of music on humans,the effects of stimulis on a organism, and much more.

#First Award - Acoustical Society of America
First Award - United States Navy Air Systems Command/London International Youth Science Fortnight
Third Award - General Motors ISEF

# A COMPARATIVE STUDY OF LEARNING, AGGRESSION, AND PERCEPTIONAL CAPABILITIES IN THE LAND HERMIT CRAB COENOBITA CLYPEATUS (HERBST)

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A total of 821 hermit crabs collected along the southwestern coast of Puerto Rico demonstrated preference for specific shell types, Astraea caelata and Tegula lividomaculata being the most numerous, and also for round over oval apertures.

To explore some of the qualities of vision in the anomuran, five crabs were trained to respond to a diamond as positive stimulus and to a cross as negative, using a T-maze apparatus with electrical shock as punishment.Discrimination margins were ahcieved after 140 trials per crab. Two shape transfers were attempted, indicating predominance of the lower hemisphere of an image in the crab's field of view and that the processing of solidity features is more important than contour orientation to the crab. The median learning rate for the hermits is given by $y = .025x + 5.3$.

The aggressive interactions of a 20 individual hermit crab group were analyzed mathematically. Coenobita had a relatively high degree of social organization, its dominance being 85.7% linear. Rank correlations were calculated for dominance position vs. chela length and vs. shell length, being chela length the more influential factor on the hierarchy. A variety of visually effective aggressive displays were described for the first time for Coenobita. In order of increasing violence these were: whole body raise, ambulatory raise, double cheliped presentation and single cheliped extension. The frequency range of the stridulatory sound produced by the crab was recorded by a spectrum analyzer, showing frequencies of 400 hertz to 1 khz. The sound was audible at 5 feet distance approximately, had an average duration of 8.5 seconds, and was produced during 3.85% of the aggressive interactions observed.

#Third Award - General Motors ISEF

#A Two Year Study of Fetal Imprinting

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The study of learning in animals is an important and vital part of behavioral experiments. The question of fetal learning and specifically fetal auditory imprinting is an area open to extensive investigation. This research is designed to determine if chickens can be imprinted to sound and variable sound frequencies during the embryonic stage and then respond to the specific sound upon hatching.

To establish positive auditory imprinting, each of three groups of fertile eggs were exposed to the sound of radio static, a high frequency sound (3000 Hertz cycles), and a low frequency sound (250 Hertz cycles). Another group was incubated with no sound to serve as a control.

To measure the response, each chick was placed in a Y maze with the various sounds projected at a given leg of the Y. The locomotor response of the chick proved that fetal imprinting did occur in each of the experimental groups.

The significance of fetal auditory stimulation and ultimate responses of the neonate is established by the results observed in this investigation. This type of cognizant behavior observed in the fetus and neonate of lower animals indicates a need for additional investigation in the area of auditory stimulation during the fetal stage.

#Third Award - General Motors ISEF

#HOW DO DIFFERENT BRAINS REACT TO DIFFERENT TYPES OF MUSIC?

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In a society, consisting of many different minds, there are many musical preferences. This is due to one of two possible reasons which are that the preferences are influenced either externally or from the preferences held by the brain. Of these, the correct hypothesis can be shown by the input of certain musical stimuli into random brains and the output of Alpha-brainwaves into an electroencephalogram. The longer Alpha-waves, indicating enjoyment, in a four-second interval were counted, charted, and decoded.

The two major brain-types are those of Alpha-P (positive, indicating that these people produce Alpha-waves constantly) and Alpha-M (minus, indicating that these people produce Alpha-waves only when relaxed). Having identified the two basic types of brains and measured the amounts of Alpha-waves, it was found that each had similar preferences, although the Alpha-P reactions were stronger than the Alpha-M reactions, despite the diversities of cultures, backgrounds, and musical preferences.

The brains'preferences, though they rarely differed, were pieces formulated mathematically, such as Bach fuges, and pastoral pieces, such as the Pachelbel Canon. However, the brains disliked music that provoked thought.

Through these tests, it was discovered that all brains react to musical stimuli in a similar manner, and that musical preferences are externally influenced.

#Third Award - General Motors ISEF

#HEMISPHERICITY : DETERMINATION AND REVERSAL PERTAINING TO VISUAL, AUDIO, EMOTIONAL, TACTILE, AND SMALL MOTOR SKILLS

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Thirty-six subjects, eighteen left-handed and eighteen right-handed, from various age groups were individually tested to determine the dominant hemisphere of the brain for tasks pertaining to visual, emotional, audio, tactile, and small motor skills. The individuals non-dominant hemisphere for these tasks was trained during a ten day period. On the fifth and tenth days both hemispheres were tested to determine if the non-dominant hemisphere was responding to the training procedures. Comparisons were made to determine which hemisphere learned better and which task the subjects responded to the most. The left-handed subjects and the right-handed subjects formed a comparison to determine which groups learned better throughout the ten day span of training. Hemisphericity was determined in left- and right-handed subjects for the individual tasks.

#Second Award - Auxiliary to the American Optometric Association
Second Award - United States Air Force

#THE GIFTED CHILD: CONCEPTION OF SELF

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This research was designed to identify program placement effects on the elementary 'gifted' student, and the parent's relationship to the gifted'child's self-concept. Two groups (twenty students each-grades four and six in the T.I.S.D. Program for the Intellectually and Creatively Talented composed the experimental 'gifted' group. Two groups (twenty students each-identical grades) in T.I.S.D.'s Nash Elementary composed the control group-'average.' (randomly composed group, not meeting selection criteria of T.I.S.D. for P.I.C.T. program.)

All groups were given the Cooper-Smith Self Esteem Inventory as an evaluation to determine self-concept. The parents of the children completed a questionnaire relating to their attitudes toward their child and her/his activities. These questionnaires were developed to reveal inner attitudes of the child/parent.

Generally, the research indicated that the 'gifted' children have a better self-conception. However, the 'gifted' children tend to feel 'upset' and 'discouraged' at school and home on more numerous occurences than the 'average' child. The 'gifted' child's parents appeared to be more supportive of their child than the parent of an 'average' child. The parents of the 'gifted' children, however, did not indicate that they focused as much attentinn as the 'average' child's parents on subjects such as reading and practical experimentation. This research indicates that such programs for the 'gifted' help the 'gifted' students accept and believe in themselves and their own ideas. Evidence indicated that parents of a 'gifted child have a close constructive relationship to their child's developing a positive self-concept.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

"Visual" INCIDENTAL PERCEPTION in Motion Pictures

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In 1957 a film containing "Eat Popcorn" and "Drink Coca-Cola" messages was shown at a theater in New Jersey. At this theater reported sales went up 57.5 percent and the sale of Coca-Cola went up 18 percent.

Since this experiment was done, others such as Levine and Dorez (1963) have performed several experiments each time disagreeing with earlier results.

Subjects for my experiments were shown a film which included five one frame clips. Then the subjects were tested to see if Incidental Perception was a possible means of relaying information. My results disagreed with the people who did the experiments in New Jersey, although they agreed with others on the fact that humans do not learn unless they are verbally told of stimuli such as the clips in my film.

Two very interesting conclusions aside from those dealing with incidental perception can be drawn from my experiment. One, being that humans do have a preference for certain shapes. The other being that humans have a preference towards certain names.

ELEMENTARY STUDENTS' PERCEPTION OF OVERWEIGHT TEENAGERS

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In this project, I will focus on and answer one question. At what age does weight prejudice begin?

I will do this by a simple written survey. The same survey will be used for all children. It will be accompanied by four pictures: one normal weight boy, one overweight boy, one normal weight girl, and one overweight girl. An example of a question is: Which one of these four people is the most popular? The survey will be given to 92 children, grades four through first. It will consist of 22 fourth graders, 26 third graders, 23 second graders, and 21 first graders. The results will be caculated in percents and graphed.

The conclusion of my project is: 1. There was not a certain grade level at which the prejudice began, as I thought there would be. 2. Weight awareness and the ability to see that thin is more acceptable starts before elementary age. 3. There appeared to be a stereotyped image of overweight people. 4. There was no evidence of severe weight prejudice.

# SCHRECKSTOFF OLFACTION IN GAMBUSIA

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The experiments performed compared the fear reactions (as perceived by the olfactory sensors) of four groups of young Gambusia affinis to the distress of a fellow and determined the origin and frequency of their responses. Two groups (I & II) consisted of four individuals who had been isolated shortly after birth and groups III & IV were composed of four young fish who were allowed to remain with their parents. Of these groups, I and III were exposed to the water in which large-mouth bass had been living to produce the experience factor. In each test a distressed adult was placed in the groups' tanks. The induction of distress caused the release of the substance which produced the fear reaction. The reaction times and frequencies of the groups' reactions were recorded, and I found that the fear response is innate; but experience increases the frequency of the reaction while decreasing the time until reaction began.

#Second Award - General Motors ISEF

BIOLOGICAL CLOCKS: A STUDY OF THE COLOR-CHANGE RHYTHM AS EXHIBITED BY THE UCA PUGNAX (FIDDLER CRAB)

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This project deals with the effect of the *Uca pugnax's* biological clock upon the crab's color-change rhythm.

The response of the fiddler crabs to natural and reversed day-night changes in illumination were tested and observed at regular six hour intervals. Included as criteria were the degrees of darkening of the crabs and the correspondence between the darkening and the low tides.

The degrees of darkening of the crabs were demonstrated to correspond to the natural day-night changes in illumination, in that, during the early morning the legs of the crabs were light, while at midday the appendages were dark. By late evening and throughout the night, the legs of the crabs were light again. A correspondence was also observed during periods of testing while reversed day-night changes in illumination were used. It was demonstrated that the legs of the crabs were dark in the mornings and evenings and light during midday.

During the experiment, additional periods of darkening were observed to correspond with the periods of low tides, indicating a marked relationship between the crab's color-change rhythm and the tides.

According to the rhythm previously established and taking into consideration that this rhythm occurs in constant cycles, it can be generalized that the *Uca pugnax's* color-change rhythm is light entrained and is reinforced by tidal rhythms, which are controlled by its biological clock.

A THREE-WAY COMPARISON: AUDIO, VISUAL, AND GRAPHIC MODES OF READING COMPREHENSION IN GRAMMAR SCHOOL CHILDREN

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Purpose: To compare the audio, visual, and graphic modes of reading comprehension, and to determine from this which of these teaching techniques are more successful for grammar school children (grades 3-8) Furthermore, to find out if age and intelligence level have an effect on how much of the reading material is retained.
Procedure: I distributed reading comprehensive passages with tests to 180 grammar school children with the aid of an overhead projector. There were four tests for each grade: A--Audio, B--Visual, C--Graphic, and D--Combination (multimedia approach). I made various charts and graphs illustrating the averages of test scores for each of the four tests: A, B, C, and D, comparing grade level and reading level.
Results: The results indicate that there is no set pattern of learning in grammar school children. Not all individuals seem to learn in the same manner. From observing my data, it seems that when comparing the audio, visual, and graphic modes, none of them appear to be particularly outstanding.
Conclusion: The students scored an average of 11% higher on Test D, in which the multimedia approach was used, than the other tests. It seems that the best way to help grammar school children improve their reading and writing skills, would be to use various devices and techniques while teaching them. This would be especially beneficial for the classroom in which children of different reading levels are combined. However, for a strong conclusion to be drawn, this experiment would have to be repeated many times and much more extensively with more control over the numerous variables involved.

#Fourth Award - General Motors ISEF

# VIDEO GAMES INFLUENCE HAND-EYE COORDINATION?

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Because of the popularity of video games throughout the nation, I wanted to know if video games improved hand-eye coordination in secondary school students.

I selected 100 students to be tested. They were then divided into one of six groups, A. Girls, B. Girl's basketball team, C. Boys, D. Boy's basketball team, E. Girl's Control, F. Boy's contol. The video game used was Wizard of War.

In connection with the local Job Service, I gave a standard dexterity test to test hand-eye coordination. The experimental groups then played the video game for five minutes. Afterwhich, they took the dexterity test again.

This experiment concluded that group A improved their hand-eye coordination gain scores at the 95% level of confidence.
Group C improved at the 90% level of confidence.
Groups B and D did not improve at the 90% or the 95% levels of confidence.

#Honorable Mention - Auxiliary to the American Optometric Association

A PROFILE OF CHEATERS

Butters, Kevin B., Clearfield H.S., Clearfield, Utah 84015
1517 S. 4000 W., Syracuse, Utah 84041

Junior High and Senior High School students and teachers were tested and/or interviewed to determine who, how and why students cheat during tests. A survey was then randomly conducted of area residents concerning their views towards honesty and the reasons which would most influence them to cheat.

The data thus obtained was then used to determine the relationships between age, sex, attitude and honesty.

#Children's Visual Understanding of High and Low in the Vertical continuum

Rundel, Karla Jo, Franklin Public Schools, Franklin, NE 68939;
1514 L St., Franklin, NE 68939.

This study examines children's (3,4 and 5 years old) understanding of height as a vertical contunuum. This idea was divided into 4 experiments. Experiment 1 is entitled position of self. It manipulates the position of the children to see if this changes their ideas of highness and lowness of the stimulus. Experiment 2, characteristic objects, was constructed to see if the children would take into consideration the characteristic heights of the stimuli, a bird and a bunny, when deciding what to label high and low. Experiment 3, neutral object, was constructed to find what the children saw as high and low and apply that result to Experiment 4. Experiment 4, compare and contrast, asks the children to take their knowledge of height one step further and apply their labels of high and low to two objects in their pre-determined high or low areas. Through statistical analysis, the variables of word (high and low), and the six different heights, (1-6 feet) were found to be statistically significant. The earlier hypothesis of a possibility of a developemental trend between ages showing up was found to be false.

#Honorable Mention - Auxiliary to the American Optometric Association

#CAN THE PSYCHOLOGICAL EFFECTS OF A TOUCH-SURROUNDED ENVIRONMENT IMPROVE THE ACADEMIC PERFORMANCE OF CHILDREN?

Wilkinson, Lora, McLoud High School, McLoud, OK 74851;
Route 3, Box 231, McLoud, OK 74851

Through various experiments, I have reached many conclusions concerning the effects of touch on elementary children. When touched while working, these children tended to be more calm, more self-confident, and more zealous about their work. Their papers were usually conducive of neatness; consequently, the children required more time to complete their work when touched, also. Generally, in the classroom males and females were affected equally. Through careful rationalization of the classroom experiments, I found that while touched, the children were inclined to have a higher level of performance; their scores decreased an average of 10% when untouched. Children who were touched while reading tended to sound out unknown words more willingly; however, when compared to reading the same story untouched, they gave-up more easily, were prone to skip words, and needed verbal assurance. Children touched in the home needed touch less than those not touched in the home; thus, they were less affected by touch than those not touched in the home. Females touched by a male missed more words when reading. When a male was touched by a male, his performance usually showed little change. The children that I concluded to be touched in the home were more able to be touched and to touch others than those not touched in the home. In a classroom where little touch was part of the environment, I found that these children were affected little by touch because they were not used to the touch. When untouched, their scores changed little. When a child is in a classroom which includes touch, their scores on classroom work are decreased when untouched. When touched his performance showed an increase over untouched scores. Also, the length of touch affected the degree it affected the child. A longer touch affected him more. The few lengthy & brief touches didn't affect his future performance.

#Second Award - United States Navy
Third Award - General Motors ISEF
Merit Award - American Medical Association
Honorable Mention - American Speech-Language-Hearing Association

#CAFFEINE'S EFFECT ON THE MIND AND BEHAVIOR - PHASE II

Dunwoodie, Peggy S., Walkersville, H.S., Walkersville, MD 21793;
7 Challedon Ct., Walkersville, MD 21793

Hypothesis - I expect caffeine to cause over excitement, confusion, and weight gain.
Purpose - My purpose is to find caffeine's effect on an animal's memory and behavior.
I. Animals -- Three groups each with 5 males/5 females. The first group was administered zero caffeine control group. The second group was administered 1 ml. caffeine solution: 1) equivalent administered to 6 cups. 2) midway group. The third group was administered 2 ml. caffeine solution. 1) equivalent administered to 12 cups coffee. 2) high group.
II. Way of administering caffeine -- 1) ingestion through mouth with pipette. 2) Caffeine to be administered in liquid form.
III. Methods and Procedures -- 1) Bring animals through maze and study their behavior. 2) Disect at least 2 males/2 females per group.
IV. Data and Results-Chi Square Test -- 1) 16 out of 18 comparisons show a significant difference. 2) 2 out of 18 comparisons show observed results.
Conclusion - Caffeine seemed to cause many disadvantages in use of the drug, such as increased irritability, confusion, and slower reaction; yet had a positive effect of the weight gain being decreased. Although caffeine decreased weight gain, it caused many bad effects which increase in severity with a larger dose of caffeine.

#Honorable Mention - United States Air Force

ARE INDIANS RIGHT BRAIN THINKERS?

Alcott, Ricky, Red Cloud Indian H.S., Pine Ridge, SD 57770
Porcupine, SD 57772

A prominent Indian psychologist, Dr. A. "Chuck" Ross, asserts that American Indians are right brain thinkers. He believes that their natural talents lie in those traits flowing from the right brain. He urges teachers to use methods that take advantage of right brain processes.

A right brain/left brain test, developed by the University of Georgia, was given to 39 sophomores at the Red Cloud Indian School. The test was programed into the micro-computer and some took the test on the computer. Others took it as a pencil-and-paper test.

Results show that only 27% are right brain dominant, while 30% favor the left brain. Integrated thinking was shown by 43% of those who took the test.

The sub-group of full-blood students revealed similar results.

Though Indians may be most comfortable in right brain activity, it seems that ten years of schooling produces students capable of integrated thinking.

MATHEMATICAL ABILITY CORRELATED TO PUBERTY

Pacey, Philip J., Keystone Heights Jr.-Sr. H.S., Keystone Heights, FL; Rt. #2, Box 389A, Keystone Heights, FL 32656.

No abstract received.

#THE ANT PILE STRIKES BACK

Calabrese, Prudence C., Belchertown H.S., Belchertown, MA 01007
26 South Main Street, Belchertown, MA 01007.

Whether or not insects possess intelligence has been a controversial subject for many years. To test ants' ability to learn, a series of conditioning and maze experiments were performed. The objective of the experiments with Carpenter Ants (*Camponotus pennsylvanicus, Degeer*)was to determine their capability to associate a given visual stimulus with a food reinforcement. The results indicated that Carpenter Ants can be conditioned to differently shaped, colored or sized objects. The ants retained the conditioned responses, without reinforcement, for an average of one month after experimentation.

The maze-learning ability of Common Garden Ants (*Tapinoma sessile, Say*) was determined by allowing them to find their way from the nest to a food source, or vice-versa, and counting the number of errors made in each trial. The ants learned their way through the maze in an average of sixteen trials. Ants traveling from the food to the nest learned the maze in fewer trials than those going in the opposite direction. The possibility of a pheromone odor trail being present was eliminated by scrubbing the area with isopropyl alcohol between each trial in every experiment conducted.

Other experiments performed indicated that ants can acquire a learned response by ingesting conditioned ants' brains. Brains from conditioned ants were mixed with graham crackers and fed to unconditioned ants. The conditioned response was observed 48 hours following the ingestion of brain material.

The conclusion of these experiments is that ants have a learning ability, but the extent of ability is as yet unknown.

#First Award - Entomological Society of America
First Award - General Motors ISEF
Merit Award - American Medical Association

A FOUR YEAR STUDY OF HEREDITARY AGGRESSIVENESS

Couvillion, Michael P., Simmesport H.S.
Simmesport, LA. 71369
P.O. Box 168, Simmesport, La. 71369

The main experiment consisted of taking a superior male fish and breeding it with a superior female fish. The offspring, F1, were then tested for aggressiveness. Four of these offspring were then bred together. The second generation, F2, was then tested for aggressiveness. By comparing the percentage of aggressiveness a conclusion could be reached.

The procedure used in testing for aggressiveness was intraspecific competition. Intraspecific competition is competition within a species. In this experiment restriction of food was used as a stimulus. Observations were made for two weeks. Observing and counting rapid approaches and nips aided in determining the most aggressive fish.

The conclusion of the experiment is that there are strong indications that aggressiveness is a hereditary trait as shown by data.

GSR-VISUAL AND VERBAL RESPONSES IN HOMO SAPIENS

Ellis, Kathleen, Levelland High School, Levelland, TX 79336
224 Country Club, Levelland, TX 79336

Human galvanic skin response is a change in electric resistance of the skin caused by the activity of the sweat glands. This response serves as a dependent variable in conditioning and is used in lie-detection tests. The purpose of this project is to see if we can detect galvanic skin responses in human subjects by using visual and verbal stimuli. By showing them pictures and asking them questions, we will see if their galvanic skin response changes with each stimulus. Procedure used was: First each person was taken one at a time to a quiet room. Then he/she was hooked up to the GSR machine and told to look at the pictures in the notebook one by one or answer yes to each question asked. While they did this I listened to sounds given off by the machine through an earplug. The results were carefully recorded. A plus for the tone going up. A minus for the tone going down. A zero if the tone stayed the same. Conclusions showed that positive responses over 50% were received from half of the visual stimuli and half of the verbal stimuli. Positive responses under 40% were received from one-fifth of the visual stimuli and one half of the verbal stimuli.

JEAN PIAGET: IS THERE A FIFTH STAGE OF COGNITIVE DEVELOPMENT?

Darby, Leigh, Brookland-Cayce H.S., Cayce, SC 29033
2601 Quail Hollow Lane, SC 29169

Jean Piaget, a Swiss psychologist, is known for his theory of cognitive development. This theory divides cognitive development into four stages of intellectual development. Espstein has developed five brain growth stages dealing with the physical maturation of the brain.

PIAGET'S THEORY	EPSTEIN'S THEORY
Stages of Cognitive Development	Brain growth stages
Sensorimotor - birth - 2 years	3 - 10 months
Preoperational - 2 - 7 years	2 - 4 years
Concrete Operational - 7 - 11 years	6 - 18 years
Formal Operational - 11 years	10 - 12 years
	14 - 16 years

The brain growth stages correlate with Piaget's stages. However there is no fifth stage of cognitive development to correlate with the fifth brain growth stage, 14 - 16 years.

Tests were developed, to determine problem find skills in students, and administered. Results point toward intellectual development after the formal stage.

EFFECTS OF PRIMARY COLORS ON VISUAL MEMORY RETENTION OF READING DISABLED STUDENTS

Higdon, Joni R., Oologah H.S., Oologah, OK 74053
Rt. 5 Canyon Oaks 1-1, Claremore, OK 74017

Color is prominent in the world today. However, little is known about its influence on learning, mainly visual memory. Reading involves the recognition of printed or written symbols which serve as stimuli for the recall of meanings built up through the reader's past experience. Therefore, improved visual memory is important to students learning to read and those with reading disabilities. The purpose of this research was to determine the effects of primary colors (red, blue, yellow) on visual memory of reading disabled students.

Equivalent reading level was the basis for selection of students to be tested. Students were introduced to a set of spelling words. Group I viewed the words printed in primary colors while Group II viewed them in standard black. A final spelling test was given. Another set of words were introduced with Group I viewing them in standard black print and Group II viewing them in primary colors. A final spelling test was given.

It was determined that the primary colors did not influence better visual memory than black. Students did enjoy use of color in studies. Further research and testing is planned before definite conclusions can be formed.

OBSERVATIONS OF THE COURTSHIP BEHAVIOR OF GREAT INDIAN HORNBILLS (Buceros bicornis)

Halker, Nils C., Edina H.S., Edina, Mn 55435;
6140 Concord Ave., Edina, Mn 55424

A pair of Great Indian hornbills were observed at the Minnesota Zoological Garden from November of 1981 to April of 1982, for a total accumulated time of thirty-eight hours. The main focus of the study was courtship behavior of hornbills in captivity.

# MALES AND FEMALES IN MATHEMATICS: IS THERE A DIFFERENCE?

Grippin, Judith L., Mansfield High School, Mansfield, Pa. 16933
RD #1, Box 6, Mainesburg, Pa. 16932

Data from standard mathematics tests was collected and divided by grade and sex to determine if sex played a role in mathematics achievement. Male and female scores were categorized into three grade levels: fourth, seventh, and eleventh grades, corresponding roughly to ages 9, 13, and 17. The data was analyzed using a statistical software package to calculate descriptive statistical values needed in another program to determine the test statistic involving two independent means. The 5% level of significance was used in the hypothesis tests. Results failed to completely confirm the experimental hypothesis and differed significantly from decades of national studies. There was no significant difference at the fourth grade level. No signifcant difference was found at the seventh grade level, but four of the six years favored the girls. Finally, except in two years which indicated that the males were significantly ahead, there was generally no significant difference between male and female scores by eleventh grade. The results indicate, but do not prove, that mathematics achievement is independent of sex.

#Honorable Mention - American Psychological Association

#THE INFLUENCE OF CONNOTATIVE LANGUAGE CLUES ON COLOR PERCEPTION

Burns, Victoria, Terrebonne H. S., 1101 W. Main, Houma, La. 70360
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Scientists disagree as to how anatomy, physiology, and psychology combine in color perception. The purpose of this project is to study color perception and to devise an original experiment that will determine the interplay of physiological and psychological factors.

Hypothesis: If physiological and psychological factors combine in color perception, color exists not only in the eye, but also in the mind of the beholder.

Method: A chart containing five shades each of the colors red, green, yellow, and blue was shown to a control group consisting of 120 subjects. After being given the Ishihara Test for Colour Blindness, the subjects were asked to select by number the truest shade of each color. A second chart, identical to the first, except that for each color, the shade that received the second greatest number of control group choices was labeled with a word that strongly connoted that color, was shown to an experimental group of 120 subjects matched to the control group by age and sex. These subjects were tested for color blindness and asked to indicate by name the truest shade of each color. All subjects over 12 were asked to complete a questionnaire designed to indicate the association of word with color.

Results: The shades which received the second greatest number of control group choices received the greatest number of experimental group choices. The converse was also true, and comparison by age, sex, and color blindness showed no significant differences. Questionnaires were used to analyze the results.

Conclusion: The hypothesis is true. Connotative language clues did influence the subjects' perception of true color.

#First Award - Auxiliary to the American Optometric Association
First Award - United States Air Force
First Award - General Motors ISEF
Third Award - American Psychological Association

BIOCHEMISTRY

AMERICAN FUEL: CORN, RICE, SUGAR CANE, SUGAR BEETS, AND SORGHUM

Spalding, Richard J., Atherton H.S., Louisville, KY 40205
113 Crestwood Avenue, Louisville, KY 40206

The purpose of this study has been to examine the process of alcoholic fermentation by yeasts, Saccharamyces, and to determine which plant is best suited for the production of ethanol fuel, C_2H_5OH, with respect to practicality, efficiency of production, and economics.

Ethyl alcohol is produced by the hydrolysis of disaccharides by yeasts. Starches, $(C_6H_{10}O_5)_n$, must be broken down by enzymatic action prior to fermentation. Of the plants evaluated, corn, Zea mays, and rice, Oryza sativa, are chiefly starchy in composition, while sugar cane, Saccharum officinarum, sugar beets, Beta vulgaris, and sorghum, Holous sorghum, are sources of disaccharides. For the latter three, sucrose, $C_{12}H_{22}O_{11}$, solutions of the same concentrations found in the sap of the plants were prepared with ordinary tap water and table sugar (sucrose). To assure that the sugar was thoroughly dissolved, the solutions were heated to 55 - 60°C, then cooled to 40 - 50°C. Dry powdered yeast was then added, and the solutions were allowed to ferment until all yeast activity stopped. At this point alcohol content is approximately 10%. The solutions were then distilled, and the relative amount of alcohol in each sample was measured.

In the case of starchy substances, the preliminary stages of fermentation require a longer process. Yeasts cannot hydrolyze complex sugars, therefore the starch must be broken down into disaccharides. To hydrate the starch, the milled grains were boiled in water. The enzyme amylase was then added to convert the starch into simpler sugars. Once this has been achieved, the remaining processes are essentially the same as for the other samples.

HOW DO DIFFERENT WAVELENGTHS OF LIGHT AFFECT THE RATE OF PHOTOSYNTHESIS?

Stellwagen, John C., Iowa City H. S., Iowa City, IA 52240
1409 Cedar St., Iowa City, IA 52240

I studied the effects of different wavelengths of light on the rate of photosynthesis in the free-floating water plant *Elodea* and the photosynthetic protozoan *Euglena gracilis*.

The *Elodea* was grown in a distilled water-sodium bicarbonate solution under different wavelengths of light and the amount of oxygen produced was measured by the amount of solution it displaced. The *Euglena gracilis* was grown under different wavelengths of light, the cells harvested, the chlorophyll extracted with acetone, and the amount of chlorophyll measured by its optical density. Both measurements determined the amount of photosynthesis that had taken place as a function of wavelength.

The results were then converted into percentages of the maximum amount of oxygen or chlorophyll produced, and the percentages were plotted on graphs as a function of wavelength. The absorption spectrum of chlorophyll was then superimposed onto each graph and compared to the percentages.

I found that the rate of photosynthesis as a function of wavelength closely parallels the absorption spectrum of chlorophyll.

A STUDY OF THE EFFECTIVENESS OF AMYLASE INHIBITORS ("starch blockers")

Miller, Keith, Opp High School, Opp, Al. 36467
501 E. Ida Ave., Opp, Al. 36467

This study used four species of bacteria. Three types that hydrolize starch for nutrition, *Bacillus cereus*, *Bacillus subtillus*, and *Bacillus megaterium* and one, *Escherichia coli*, which is incapable of utilizing starch, was used as a control organism.

Commercial "starch blockers" in recommended dosage amounts (¼, ½, 3/4, 1 and 2 tablets) were added to starch agar in petri dishes and streaked with the four types of micro-organisms. These dishes were incubated at optimium temperatures for twelve hours and then photographed. Observations and conclusions were suggested using Gram's iodine solution to indicate amounts of starch actually used by the growing cultures. The original hypothesis relative to ineffectiveness of these inhibitors was found to be valid.

#INCREASED TRANSPOSITION FREQUENCY OF *TN10* IN *E. COLI* K-12

Erlebacher, Adrian I., Cheltenham H.S., Wyncote, PA 19095;
7733 Mill Road, Elkins Park, PA 19117.

Transposon *Tn10* is a discrete unit of DNA that is capable of replicating itself into other DNA segments, a process called transposition. *Tn10* transposition is mediated by the *IS10* segments at its ends. Previously, two bacterial strains were discovered by the author to exhibit a greatly increased *Tn10* transposition frequency. This phenomenon was termed the "hyper-hop" phenotype. In this study, various characteristics of the "hyper-hop" phenotype are reported: (i) the "hyper-hop" phenotype is *recA* dependent; (ii) the "hyper-hop" phenotype is abolished after an initial transposition event in a "hyper-hop" cell; and (iii) a non-random insertion specificity results from the "hyper-hop" phenotype. These properties suggest that the cause of the "hyper-hop" phenotype is homologous recombination between a residual chromosomal Tet^S *Tn10* fragment and the incoming *Tn10*, indirectly providing evidence for independent *IS10* transposition - postulated, but never observed. Another possibility that is not ruled out, however, is that the "hyper-hop" phenotype is caused by the existence and action of a host transposition gene, normally repressed or non-functional, that is being expressed functionally in a "hyper-hop" cell.

#Second Award - General Motors ISEF
Honorable Mention - American Chemical Society

#EFFECT OF NUCLEAR PROTEIN AND DNA METHYLATION ON GENE EXPRESSION IN CANCER CELLS

Shapira, Nathan A., Briarcliff H. S., Atlanta, GA 30329;
954 Liawen Court, N. E., Atlanta, GA 30329

Recent work from many laboratories suggests that methylation of specific sites in DNA is a developmental regulatory mechanism. DNA and nuclear proteins, histones and high mobility group (HMG) proteins, of human promyelocytic leukemic cells (HL-60) were studied in dividing and differentiated cells. HL-60 cells grown in tissue culture in the absence and presence of arginase or DMSO were isolated after 1-4 days, lysed, and their nuclei purified and extracted to give nuclear proteins and DNA. Cells treated 3-4 days with arginase or DMSO differentiated and contained less HMG proteins. ^{14}C-Formate added to treated and untreated HL-60 cells 1 day prior to harvest was found mainly in the region of the H_2 and H_3 histones. The nuclear proteins from each cell type were separated by HPLC, assayed for radioactivity, and divided into 8 pools which were assayed by SDS-slab gel electrophoresis and amino acid analysis. Most of the protein radioactivity was found in serine, but small amounts were found in S-methylcysteine. DNA was enzymatically digested to deoxyribonucleotides. Small amounts of 5 methyl deoxycytidylic acid (5-Me-dCMP) and an unknown nucleotide were found labeled in the arginase and DMSO cells. The percentage 5-Me-dCMP of the total dCMP was 2.1% in untreated 4-day HL-60 cells, 7.3% in cells treated 4 days with DMSO, 2.8% in cells treated for 1 day and 12.6% in cells treated 4 days with arginase. Calf thymus DNA contained 6% 5-Me-dCMP. HL-60 leukemic cell DNA is undermethylated compared to normal cells and differentiated cells. The differentiated HL-60 cell DNA was overmethylated compared to normal cells. When the DNA was undermethylated, the nuclear proteins were more methylated, and vice versa. Thus methylation of DNA may turn genes off, and conversely methylation of nuclear proteins turns genes on.

#First Award - General Motors ISEF
Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society

Minerals in Leafy Vegetables

Lewis, Jon F., Cedar Creek School, Ruston, LA 71270
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The objective in this project was to determine the content of four (4) minerals in eight (8) different cooked and uncooked leafy green vegetables. The vegetables were dried at 70°F. for 24 hours, and ground up in a plant tissue grinder. The plant material was digested by adding 5 ml of concentrated nitric acid to 5 gm of each ground vegetable, and boiling until the brown frothing ceased. Enough 30% hydrogen peroxide solution was added until all the brown color disappeared; heating was continued. When the brown color reappeared, the solution was allowed to cool, and brought up to volume in a 50 ml volumetric flask. Percentages of the following minerals were determined, using the standards and a blank on a Bausch and Lomb Spectrophotometer 20 at the given wavelength: 1) Phosphorus - 5 ml plant extract, 35 ml distilled water, 10 ml ammonium molybdate, 3 drops tin (II) chloride; 650 millimicrons; 2) Magnesium - 15 ml plant extract, 21 ml distilled water, 2 ml compensating solution, 2 ml clayton yellow, 10 ml 2N sodium hydroxide (set for one hour); 550 millimicrons; 3) Calcium - 4 ml plant extract, 1 ml oxalic acid (set for 30 minutes); 420 millimicrons; 4) Potassium - 5 ml plant extract, 3 ml 70% isopropyl alcohol, 0.1 gm sodium cobaltnitrate (shake, set for 5 minutes, shake again); 700 millimicrons. Conclusions: the following vegetable was found to contain the highest percentage of the mineral listed: 1) Phosphorus - raw turnip greens, 0.0515%; 2) Magnesium - raw turnip greens, 0.158%; 3) Calcium - cooked collards, 5.94%; 4) Potassium - raw spinach, 0.36%.

#TESTOSTERONE CONTROL OF GENE EXPRESSION AND CELL DIFFERENTIATION

Tseng, Ernest E., Highland H.S., Highland, IN 46322
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This research revealed that testosterone serves as a signal for the activation of a gene set (A), which codes for certain proteins (including enzymes) responsible for the normal development and functions of the epithelial cells in the prostrate. With the depletion of testosterone, gene set A is not activated. However, the other gene set (B) continues to function, resulting in a degeneration of epithelium and the over development of muscle and connective tissue. These generalizations were documented as follows: the testosterone level was regulated by rat orchiectomy and replacement therapy. Gene activation was observed by such products as acid phosphatase and total proteins. The acid phosphatase was measured kinetically and by gel electrophoresis, while total proteins were detected by ISO-DALT 2 D-electrophoresis. The development of epithelial cells versus muscle and connective tissue was documented by light and electron microscopy. A testosterone-protein complex is postulated to initiate transcription by binding with the anti-sense strand of DNA (possibly due to its base sequence), thus allowing the sense strand to transcribed by the RNA polymerase. Comparative studies of the Vmax and Km of the enzyme acid phosphatase in eight organs of experimental and control rats confirmed that the prostrate and seminal vesicles are the primary target organs of testosterone. Furthermore, eight isozymes of acid phosphatase were characterized by various inhibitors.

#First Award - Eastman Kodak Company
Second Award - General Motors ISEF

#HUMAN PLASMA PLATELET RESPONSE TO IN VITRO AIR ION EXPOSURE

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Hills, MI 48013.

The majority of air-ion research has indicated a decrease in mammalian serotonin levels due to exposure to high concentrations of negative air ions. The mechanism of the 'serotonin effect', however, remains unknown. Considering that 90% of all human serotonin is stored in blood platelets, and that serotonin must be released from the platelet in order to be effective, an ion-platelet interaction emerged as a probable explanation for the serotonin effect of air ions.

Platelet-rich-plasma (PRP) obtained from human subjects was exposed to 4.0 x 10^5 ions/cm^3. A current density of 1.0 x 10^{-13} amps/cm^2 passed through the medium while unidirectional, filtered air flowed at 15 ft/min in the 4-liter-flask chambers. A tungsten-tipped wire served as a ground for the medium, while an 8 mm magnetic teflon stirring bar was activated continuously.

Experimental and control PRP samples were analyzed every 10 mins (120 mins total exposure) for an analysis of platelet-count (PC), mean-platelet-volume (MPV), and platelet aggregation. PC and MPV data supported the contention that negative ions do not stimulate platelet-serotonin release. Aggregation data, however, indicated that the ions initiated a minimal (6%) inhibition of aggregation, indicative of an equally minimal inhibition of platelet-serotonin release.

The results indicated that high concentrations of negative air ions minimally inhibited platelet-serotonin release (most likely through the stimulation of the membrane-bound enzyme adenylate cyclase), and established the blood platelet as a likely target of air ions in in vitro human plasma preparations.

#Second Award - United States Air Force
Fourth Award - General Motors ISEF
Merit Award - American Medical Association

THE ROLE OF STARCH BLOCKERS IN ALPHA-AMYLASE INHIBITION

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The purpose of this study was to determine if starch blockers inhibit alpha-amylase activity (in-vitro).

The enzyme alpha-amylase works in the body's digestive tract to convert starch into maltose. Starch blockers are said to inhibit the activity of this enzyme preventing starch from being broken down and causing a loss in weight. In order to determine the answer to my problem, I performed five experiments, asking myself the following questions: 1) At what pH do starch blockers work best? 2) What effects do temperatures have on alpha-amylase? 3) Will preincubation of starch blocker with starch inhibit alpha-amylase activity? 4) Will the preincubation of starch blockers and alpha-amylase inhibit alpha-amylase activity? 5) Will the preincubation of starch blockers and starch in gastric fluid result in an inhibition of alpha-amylase activity? After doing extensive research and testing, I was able to determine the following: 1) Starch blockers work best at a pH of 5.0. 2) Alpha-amylase works best at body temperature. 3) The preincubation of starch and starch blockers does not inhibit the activity of alpha-amylase. 4) The preincubation of starch blockers and alpha-amylase does not result in an inhibition of alpha-amylase activity. 5) The preincubation of starch and starch blockers in gastric fluid does not inhibit alpha-amylase activity.

In analyzing all data obtained through research, I concluded that starch blockers do not inhibit alpha-amylase activity, thus disproving the weight-loss theory advocated by the manufacturers of the starch blockers.

#EFFECTS OF ASCORBIC ACID DEFICIENCY ON HMG-CoA REDUCTASE ACTIVITY

Greene, Yvonne J., Merritt Island H.S., Merritt Island, FL. 32952
1605 Diana Blvd., Merritt Island, FL. 32952

Microsomal 3-Hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase is the rate-limiting enzyme for mammalian cholesterol biosynthesis. The potential involvement of ascorbic acid (vitamin C), in cholesterol metabolism has attracted considerable attention over the years. Studies have shown that in chronic ascorbic acid deprivation there is an elevation in plasma and tissue cholesterol in the guinea pig. Elevated plasma cholesterol levels are considered to be a risk factor in the pathogenesis of atherosclerosis.

This project was designed to study the effects of ascorbic acid deficiency on the activity of HMG-CoA reductase and on the in vivo rate of cholesterol synthesis in the guinea pig. Variations in the diurnal rhythm in HMG-CoA reductase activity were also examined.

For this study 30 male Stars and Bars guinea pigs were fed either control guinea pig lab chow (contains ascorbate) or ascorbic acid deficient lab chow ad libitum for 2 weeks prior to enzyme isolation and determination of the rate of cholesterol biosynthesis. Reductase activity was measured by the quantitation of conversion of [3-^{14}C] HMG-CoA to mevalonic acid from prepared hepatic microsomal reductase. After conversion to mevalonolactone, this was separated from other radioactive compounds by thin layer chromatography and counted. The rate of cholesterol synthesis was determined by the quantitation of tritiated water incorporated into triglycerides and cholesterol in the guinea pig liver.

Results have shown that in ascorbic acid deficiency there is a decrease in reductase activity and the rate of cholesterol synthesis, and that guinea pigs do have a diurnal rhythm in reductase activity.

#Second Award - United States Navy
Third Award - General Motors ISEF
Honorable Mention - United States Air Force

#THE EFFECT OF SUBSTRATE AND ADENOSINE 5' MONOPHOSPHATE (AMP) ON THE REVERSAL OF THE ZINC^{++} INHIBITION OF THE AVIAN EMBRYO LIVER FRUCTOSE-1,6-BISPHOSPHATASE (FDPASE) BY CHELATORS

Council, Stevie R., Benjamin E. Mays High/Academy, Atlanta, GA 30331; 2198 Star Mist Drive, S.W., Atlanta, GA 30311

The purpose of this research is to determine the effect of substrate and adenosine 5' monophosphate (AMP) on the reversal of the Zn^{++} inhibition of the avian embryo liver fructose-1,6-bisphosphatase (FDPase) by chelators.

The procedure used a species of the avian embryo (840 specimen were used). The liver FDPase was purified. The assay mixture was then treated to eliminate the endogenous Zn^{++}. The activity of the liver FDPase was then inhibited. Afterwards the effect of substrate and AMP were tested on the reversal of the enzyme inhibition.

It was found that the ability of chelators to reverse Zn^{++} inhibition of avian embryo liver FDPase decreased greatly if substrate is first bound to the enzyme. If AMP is also present, chelators became almost completely incapable of reversing Zn^{++} inhibition when added to the enzyme after substrate. These observations indicate that the prior binding of substrate to this FDPase hinders the removal of Zn^{++} from the inhibitory sites of the enzyme by chelators, especially when AMP is also present. I have also found that the initial rates of the Zn^{++} inhibited enzyme activity show a peculiar nonlinearity and the inhibitory effects of Zn^{++} and AMP are synergistic.

#First Award - American Chemical Society
First Award - Patent Trademark Office/U.S. Department of Commerce/ Patent Office Society
First Award - United States Army
Fourth Award - General Motors ISEF

THE ISOLATION, IDENTIFICATION, AND MICROBIAL TRANSFORMATION OF THE ALKALOIDS OF HYDRASTIS CANADENSIS

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Phytochemical investigations of Hydrastis canadensis have yielded three distinct alkaloids (hydrastine, berberine, and canadine).

A study was designed to isolate hydrastine and berberine from the plant. Lipids were removed from the plant material by a hot hexane reflux. The marc was then refluxed successively with hot 95% ethanol, yielding fraction E. Fraction E was evaporated to dryness, acidified with 1% HCl, filtered, and rendered alkaline to a pH of 12 with 28% NH_4OH. This mixture was then extracted with chloroform to remove the alkaloid bases.

Column chromatography yielded two distinct alkaloids which were identified by infrared and ultraviolet spectroscopy and determined to be hydrastine and berberine.

Since some alkaloids undergo structural changes when acted upon by certain bacteria, a microbial study was incorporated to determine if the action of ten common pathogens might result in any structural modifications of the purified alkaloids.

Ten 100 mg. samples of each alkaloid were dissolved in 20 ml. of a mineral-salts solution, innoculated with separate pathogens, and incubated for 10 days at 37C. Carbon and nitrogen sources other than the alkaloid were excluded from the culture medium.

The partial transformation of hydrastine by Mycobacterium smegmatis was determined utilizing thin-layer chromatography and infrared spectroscopy. The nitrogen portion of the hydrastine molecule appears to be a major point of bacterial attack, and the change in the amine character of the alkaloid has been noted.

THE COMPARISON OF CHEMICALLY ALTERED THYROID, ADRENAL, AND HYPOTHALAMIC STATUS IN MICE USING AN ENERGY DISPERSIVE X-RAY SPECTROMETER

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The purpose of this project was to compare the effects on the elemental compositions of chemically altered thyroid, adrenal, and hypothalamic status in Swiss-Webster mice, *Mus musculus*. The effect of a thyroid hormone deficiency on the adrenal gland response was the reason for this comparison. Twenty, male, Swiss-Webster mice of about four months of age were used in this experiment. Five of these twenty mice were simple euthyroid specimens; five were euthyroidic mice each injected with one unit of a hormone naturally secreted by the pituitary gland each day for four days; five were specimens that were exposed to a drug that induces hypothyroidism from conception; five were exposed to that drug from conception and four units of the hormone mentioned above were injected into each of these five mice. All of the mice had their hypothalamus, thyroid and adrenal glands excised. Five hypothalamus glands, ten adrenal glands, and ten thyroid from each of the four specified conditions mentioned above were apportioned into pools. Each pool was weighed separately and their weights were tabulated. Each pool was then desiccated and weighed again. The amount of water contained in each pool was then determined and percentages ofwater were calculated. Each pool was then prepared for observations under an x-ray spectrometer. With the use of an energy dispersive x-ray spectrometer, the elemental compositions of the glands were determined. The quantex-ray graphs revealed no outstanding differences in the elemental compositions of the glands, and no direct correlation between a thyroid hormone deficiency and adrenal gland response in mice.

DETERMINATION OF BIOGENIC AMINES IN GASTROPODA UTILIAING HIGH PRESSURE LIQUID CHROMATOGRAPHY WITH ELECTROCHEMICAL DETECTION

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Biogenic amines are of primary importance and interest in neurochemical research. These chemicals are involved in neurotransmission. In this study, a method has been developed to qualitatively and quantitavely assay various biogenic amines using high pressure liquid chromatography with electrochemical detection (HPLC-EC). HPLC-EC is a relatively new procedure which allows for the separation and detection of small quantities of various compounds. The present assay conditions separate and detects nanogram concentrations of dopamine, serotonin, homogenistic acid, homovanillic acid, norepinephrine, epinephrine, and 5-hydroxy-3-indoleacetic acid. The present study identifies, for the first time, the distribution of the described bioganic amines in the subesophageal ganglion of the Florida Apple Snail (*Pomacea paludosa*) and the Albino Mystery Snail (*Viviparus georgianus*). More significantly, these species show they may be used as a primary research tool for determining the activity of a drug on the metabolism of biogenic amines. In terms of evolutionary biology, this study adds to the matrix of data confirming the close evolutionary relationship the animal kingdom shares. The next step will be to establish physiological levels of biogenic amines in these specimens and perform inhibition studies. My thanks to Mr. Anthony Okonmah and Dr. Wilson G. Bradshaw, faculty members of the Florida A&M University Pharmacokinetics and Basic Research Laboratory at the Veterans Administration Medical Center in Miami, Florida.

PHYSIOLOGICAL STUDY OF THE EFFECTS OF A LACTUCA SATIVA COMPONENT IN CALCIUM BINDING OF SKELETAL MUSCLE MITOCHONDRIA IN LEPUS CUNICULUS

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The genus Lactuca (lettuce) has been used as a sedative in traditional Puertorican Folklore. Different types of experiments were performed in order to investigate the depressant action of a lettuce component in the locomotor activity and physiology of different animals. It was found that the purified active component acted as a depressant agent in cardiac, smooth and skeletal muscle preparations of the animal. The depressant effect was not related to neuromuscular transmision but rather to the inhibition of muscular contraction. The effect on the muscle was anatagonized by administration of calcium, therefore, we investigated the effect of the Lactuca component on the mechanism of calcium binding of skeletal muscle mitochondria.

Rabbit gastrocnemius muscle was homogenized and centrifuged to isolate the mitochondrial fraction. Calcium uptake was measured by calcium-sensitive indicators and by the use of ferric chloride and sulfosalicylic acid (colorimetric tests). The results showed that the rate of mitochondrial calcium binding was affected by the addition of the Lactuca component. This effect was not related to enzymatic activity as demostrated by subsequent experiments.

Further studies using radioactive calcium (Ca ^{45}) may help to determine the specific mechanism of action of the Lactuca component on calcium-mediated excitatory processes.

#THE INDUCTION OF BOVINE INTERFERON THROUGH THE USE OF IBR-PI3 INTRANASAL VACCINE, Sieberns, Cindy, North Harrison H.S., Ramsey, IN 47166; Rt.3 Box 617, Corydon, IN 47112.

Infectious Bovine Rhinotracheitis-Parainfluenza Three (IBR-PI3) intranasal vaccine is a widely-used intranasal vaccine. Interferon can be induced by using IBR-PI3 vaccine containing a modified live virus. The virus sends off "fake" signals to build up cell's resistance to IBR-PI3. The virus is modified to build up permanent antibodies and not to cause the disease. IBR-PI3 is an ideal inducer of interferon in cattle.

Isolating the interferon is a problem that can be overcome. Interferon is isolated from nasal secretions. Secretions are collected using sanitary tampons, which are inserted into the nasal passages. The secretions are centrifuged and the supernatant removed. The interferon containing supernatant is assayed for anitviral activity.

The interferon can later be used for further study. All interferons, despite their origin, work in the same way. The species-specific character of the protein does not alter its functions in the body. The method by which bovine interferon stops viral infection can be beneficial in studying the action of human interferon.

#First Award - American Medical Association
First Award - American Veterinary Medical Association

#INTERRELATIONSHIPS BETWEEN DIETARY FATTY ACIDS AND PROSTAGLANDIN E_2 SYNTHESIS: A PATHWAY TO MAMMARY TUMOR GROWTH.

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Linoleic acid, an essential fatty acid, is the primary indirect precursor to Prostaglandin E_2 (PGE_2) synthesis. Prostaglandin E_2 has several immunological implications, one of which is suppression of cytotoxic mechanisms of leukocytes. Although the suppressive effects of PGE_2 on various immune functions have been well documented, the relationship between dietary fat consumption and PGE_2 synthesis have not been established. Therefore, studies were performed to determine the influence of dietary fat and indomethacin treatment on the growth of transplantable, metastatic, mammary tumors, and the biosynthesis of PGE_2 by splenic mononuclear cells.

Rats at 21 days of age were injected in the right inguinal lymph node area with 5×10^3 tumor cells. At this time, rats were placed on either Purina Lab Chow or specially designed diets containing 2%, 5%, 10%, or 20% stripped corn oil. In treatment groups, indomethacin was provided via drinking water to give a final dosage of 2.5 to 3.0 mg indomethacin/kg body weight/day.

Rats were allowed to grow for 35 or 50 days, at which time, rats were sacrificed. Blood serum was drawn to measure fatty acid absorption. Spleen were removed and prepared for PGE_2 assays. Lymph nodes were excised, weighed, and histologically prepared for microscopic evaluations of tumor presence.

Results indicated: (a) the rate of tumor growth and PGE_2 synthesis increased as dietary fat increased; and (b) both effects were reduced by indomethacin treatment.

#First Award - United States Air Force
First Award - United States Navy/London International Youth Science Fortnight
Third Award - General Motors ISEF
Merit Award - American Medical Association
Honorable Mention - American Chemical Society

CHEMICAL INHIBITORS IN SEED GERMINATION

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An experimental study was performed to determine the effects of water soluble chemical inhibitors present in naturally occuring rye grass seeds on the germination rates of radish, beet, corn, and lima bean seeds. The inhibitor was separated from the rye grass seeds. Distillation and centifuging were used to concentrate the inhibitor. Water and inhibitor solutions were then used to germinate the seeds. Germination rates were determined by counting the number of seeds germinated as a function of time. The inhibitor containing solutions significantly reduced germination rates. The RNA of the rye grass seed was removed from the seeds by grinding the seeds and treating them with a sodium hydroxide solution in a steam bath for one hour. The resulting solution, separated by filtration from the seed pulp, was treated with methanol/hydrachloric acid solution to precipitate the RNA. The RNA was separated and dried. Ascending paper chromatography was then used to separate the amino acids in the RNA. Using a solvent system containing a n-butanol-acetic acid-water, paper chromatograms were run for samples of RNA from rye grass seeds and samples of known amino acid indicator, and examined under black light. The comparison with known amino acids revealed that the RNA from rye grass seeds contained L-Lysine.

#LATEX RUBBER FROM ARTOCARPUS ARTILIS TREE

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Rubber is an elastic substance which can be obtained from the latex of various plants that grow in tropical lands. On our island, the breadfruit tree for many years, has been used for nutritive purpose.

The purpose of the investigation was to see if we could obtain from the latex of the breadfruit tree (abbreviated: rubber B). After extracting and filtering one liter of the breadfruit tree latex, and adding 0.4ml of 4% acetic acid, coagulation took place. We extracted the excess water with a cylinder.

Never before produced, creating rubber B, became the success of the investigation. While testing one of the properties of rubber, elasticity, we discover it reaches more than its double size. Conducting a heat resistance test comparing it with comercial rubber, the results were, rubber B was as resistant as the comercial rubber, been practical and useful. Other investigations being done on the latex of this tree are: the search of new types of rubber by using fibers, obtaining other products from it, the use of rubber B as an alternative for partial replacement of petrochemicals, and the explotation of its comercial value. We are investigating some comercial importance products using the breadfruit.

The tree doesn't need extreme soil preparation and it can be grown in almost any types of tropical lands. Breadfruit tree plantations can be the answer to the economical situation which our island and other parts of the world are confronting in their search for economical stability.

#First Award - General Motors Corporation

#THE ROLE IN PHOTOSYNTHESIS OF THE CAROTENOIDS

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It has long been known that all green parts of plants contain not only chlorophyll but carotenoids. What is not known, however, is the specific role of the carotenoids in the daily functioning of the plant. The purpose of this experiment was to investigate the opposing theories of Noack and Went, who viewed the carotenoids (carotene and xanthophyll being the main ones) as light energy transmitters and sensitive enzyme protectors respectively. There would seem, however, no reason why the two theories could not co-exist, with the carotenoids relaying light energy as a booster to chlorophyll A and at the same time monitoring such transmissions so as to remain at optimum level.

To prove this, sprigs of *Elodea* were positioned 1 meter away from lights of intensity 7.5 to 200 watts, with oxygen from the subsequent photosynthesis being collected. After obtaining average values for oxygen released at each level, a ground and filtered solution of carrots (prime source of carotene) replaced the previous enrironment of water. Oxygen production increased rapidly, indeed almost tripling.

The large jump in oxygen production surely confirms the active role of the carotenoids in photosynthesis. Adding further proof to this were chromatograms, which indicated a significant rise in the carotene levels of the enriched *Elodea*. The excess of carotenes, apparently, provided a greater capability for transferral of light energy to the reaction-triggering chlorophyll A. This would result in more rapid cycles of photosynthesis, thus accounting for the accompanying rise in oxygen production. At the same time, the added "protection" of the excess carotenes increased the level of intensity of light able to be withstood. For whereas oxygen production among *Elodea* in a water environment held a constant rate from 100-150 watts, that of *Elodea* in the carotene solution continued to follow an upward curve beyond the 200 watt mark.

#Fourth Award - General Motors ISEF

SOMATIC CELL HYBRIDIZATION: A BIOCHEMICAL ANALYSIS AND CELLULAR CHARACTERIZATION

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I compared the efficiency of two similar fusion agents and produced, isolated and studied the resulting hybrid cells. WI-38 human lung fibroblasts were fused with both L-1210 and P388 mouse Leukemic lymphiod cells, using the fusion agent polyethelene glycol (PEG) of two molecular weights (1450 and 1000). The efficiency of the PEG of each mol. wt. was determined by calculating the number of hybrids per mm^2. I seeded the cell lines in 30 ml. tissue culture flasks and incubated them for several weeks. During this period I prepared the PEG. I then removed the monolayer of fibroblasts using trypsin and concentrated them by centrifugation. I also concentrated the suspended leukemia cells. Various mixtures of the fibroblasts and leukemias were exposed to the PEG, then reseeded in 30 ml. flasks and glass tissue culture tubes containing coverslips. The cells were then incubated at 35°C. Some mixed cells were stained with May-Greenwald-Giemsa and were observed after two weeks. I looked for cells in various stages of cell fusion, particularly fusing cells showing intercellular bridges and fused cells with multiple nuclei. Some of the fused cells were heterokaryons with nuclei from both parent cell lines. After mitosis the nuclei of the hybrid cells are not typical of either parent cell line. They are readily discernable and are referred to as synkaryons. The chromosomes in these atypical nuclei were a mixture of both parent cell phenotypes. My hope, eventually, is to produce my own hybridoma cell line. Cell lines were supplied by the UpJohn Company, Kalamazoo, Michigan.

#USING VITAMINS A AND E TO PROTECT CORN POLLEN FROM CHROMOSOMAL ABERRATIONS CAUSED BY X-RADIATION AND COBALT-60

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ABSTRACT: When radiation strikes a pollen cell free radicals are formed. Free radicals are positively charged particles and therefore seek electrons. Electrons are taken from vulnerable cell components. When electrons are taken from DNA molecules, chromosomal aberrations occur. Vitamins A and E are antioxidants. An antioxidant is a molecule which readily gives up its electrons. The purpose of this project was to determine if aberrations could be reduced by adding antioxidants to the medium in which pollen grains were irradiated.

Corn homozygous for dominant Anthocyanin gene was planted in one plot and corn homozygous for recessive Shrunken gene in another. Plants matured and silks of Shrunken corn were covered. Pollen from the Anthocyanin corn was collected and put in four containers of mineral oil to keep it alive. Vitamin E was added to two containers. One vitamin E and one control solution were exposed to 1200 rads of X-radiation, two containers to 4000 rads. Pollen was placed on the silks of Shrunken corn plants. When the ears matured, seed was collected and results recorded. In a second study, vitamins A and E were used and pollen exposed to Cobalt-60. Again results were recorded. Kernels of this cross should show dominant Anthocyanin gene. Shrunken kernals are due to chromosomal aberration of this dominant gene in the pollen cell allowing expression of the recessive gene.

The vitamins used in this study significantly reduced chromosomal aberrations in the pollen exposed to X-radiation and Cobalt-60.

#Fourth Award - General Motors ISEF

FRUIT OF MACLURA POMIFERA: DETERMINATION AND IDENTIFICATION OF A NATURAL CHEMICAL REPELLENT OF ACHETA DOMESTICUS (HOUSE CRICKETS) BY SIMPLE CHOICE HABITAT AND GAS CHROMATOGRAPHY/MASS SPECTROSCOSCOPY

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Folklore states that hedgeapples repel insects. The research was done to determine if house crickets are repelled by hedgeapples and what compound is the most effective repellent. Crickets were first determined to be repelled in a simple choice habitat. The habitat consisted of a large glass crystallization dish with two inverted plastic cups as test shelters, one blank and one containing the substance to be tested. Observations of which shelter each cricket was in were taken, and the repellency determined. Fractional distillation, head space analysis, and a continuous extraction utilizing a Soxhlet extractor were used to obtain samples of volatile compounds present in hedgeapples. These samples were injected into a gas chromatograph/mass spectrograph interface for identification, and then verified. The samples were then tested in the simple choice habitat for repellency to crickets. Results showed that hedgeapples repelled crickets 92% of the time. Acetaldehyde, phenol, and ethanol were identified as likely compounds present in hedgeapples. Acetaldehyde was 94% repellent, phenol was 99.3% repellent, and ethanol was shown to be 84.9% repellent. The conclusions that hedgeapples do repel crickets, acetaldehyde and phenol are excellent repellents, and that ethanol is not as good a repellent were drawn. Also, phenol was found to be the best repellent identified thus far.

#EFFECT OF ETHYL ALCOHOL ON CELL MEMBRANE PERMEABILITY

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The purpose of this experiment is to determine what effect, if any, ethyl alcohol has on the permeability of a cell membrane. The cell membrane is remarkable in its ability to be selectively permeable to different substances, without which the structural integrity of the cell and life itself would be impossible. In order to determine what effect exposure to ethyl alcohol has on this permeability I am using fluorescein diacetate (FDA). This substance is a clear, nonfluorescing liquid which is permeable to the cell membrane. When it is added to a suspension of cells it passes through the membrane at a set rate and enzymes inside the cell remove the acetates, leaving pure fluorescein, a fluorescent substance which is not permeable to the cell membrane and therefore cannot get back out. The rate of increase on fluorescence in this solution is measurable and is proportional to the rate at which the FDA passes through the membrane.

In order to see this effect it was necessary to build a fluorimeter which utilizes fluorescein's characteristic absorption and emission spectra of 480 nM and 520 nM respectively. The cell suspensions consist of Chinese hamster line cells suspended in an appropriate medium which were cultured at 37 degrees Celsius. The results were normalized to unit concentration. This system has shown itself to give results which are reproducible within reasonable limits of error.

#Honorable Mention - American Chemical Society

THE EFFECTS OF NORETHINDRONE AND MESTRANOL (PROGESTATION STEROIDS) ON THE DROSOPHILA MELANOGASTER FEMALES

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This investigation is an electron microscopic study of the genetical effects of progestation steroids on the Drosophila melanogaster. Progestation steroids are synthetic drugs that influence the reproductive system of mammals by activities which take place through inhibiting pituitary gonadotrophins. The action of such drugs in Drosophila reproductive system is unknown and serves as a basis for this study. Virgin females of Drosophila melanogaster were allowed to feed on media treated with one and two dosages (one dosage is equilivant to 0.05 mg Mestranol and 1.0 mg Norethindrone) of Norinyl 1+ 50^{TM} in 100 mls 1% sucrose for 72 hours. After this exposure treated virgin flies were allowed to mate to females of arising progeny and its ovaries were sacrificed. The ovaries obtained were stained and prepared for further observations using American Optical Phase-Contrast Light Microscope and the Philips 201 Electron Microscope. Observations revealed that depedent upon treatments, ovarian tissues of progeny were either to underdeveloped for oogenesis or hyperactive. Progeny of females treated with one dose of Norinyl 1+50^{TM} exhibit an increase frequency of necrotic ovarian tissue and in those that recéive treatment of two doses had numerous mature yolk cells and "A-bodies" that are thought to promote fertility in their hosts.

BOTANY

#A COMPARATIVE ECOLOGICAL, TAXONOMICAL AND ZONATION STUDY OF THE THREE LICHEN SPECIES, ARTHONIA, LECANORA AND PYXINE IN THE COASTAL ZONE OF THE ISLAND OF PUERTO RICO

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The main purpose of this study is to investigate the climatic conditions that influence the density and zonation of the three lichen species (Lecanora, Arthonia, Pyxine) in the coastal zone of Puerto Rico.

It was discovered that a correlation does exist between the precipitation, oxidant and sulfur dioxide with the lichen density, and that a correlation does not exist between temperature, relative humidity and salinity with the lichen density.

At the different beaches visited, I found a pattern of lichen density, beach distance and environmental parameters. In this study I found two news species of lichens in Puerto Rico.

I found that the pattern of lichen association was:

#1. Arthonia - Pyxine
#2. Arthonia - Lecanora
#3. Pyxine - Lecanora

#First Award - General Motors ISEF

#THE EFFECTS OF SEASONAL CHANGES ON SOIL ORGANIC MATTER

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The soil formation is the most important factor in community succession. Its relationship and influence on the physical and chemical propetries of soils in an ecosystem is greatly influenced by the amounts of organic matter present. Does organic matter content vary with seasonal changes in the physical environment? If it does, what causes the fluxuations and when is its concentration the highest?

To find data to support this, measurments such as relative humidity, soil and atmospheric temperatures, and amounts of precipitation were made in the physical environment on a regular basis. The organic matter content was found by a method in which weight loss due to combustion represented the amount of organic matter.

The data collected clearly illustrates that the amount of organic matter present in soil fluxuates. The amounts ranged from one to six percent.

The second question could not be answered because the results were not definitive enough to show which aspect of the climate is most important. No direct correlations could be observed between any of the conditions because the time required for organic matter to form depends on the characteristics of the soil. The researcher believes the closest correlations are in the influence of the soil temperature; however, the data does not totally support this statement. This theory is proposed because of the influence of soil temperature on the reaction rate in organic matter formation.

#Fourth Award - General Motors ISEF

#A STUDY OF THE SULFUR REQUIREMENTS ON CHLORELLA VULGARIS

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This study is being conducted to find the sulfur requirements utilized by Chlorella. Investigators sometimes use Chlorella, a unicellular alga, to study the process of photosynthesis. In addition to that purpose, it is being extended as a food supplement for the people of the underfed nations of the world. It is higher in protein content than most typical animal feeds. It contains a 50% average protein content. The growth requirements of Chlorella have not been fully studied. Not every kind of sulfur-containing compound can be utilized by Chlorella. Therefore, the kind and quantity of sulfur that this plant needs requires some study.

Each test was administered in triplicate. Two controls were established; one, a sulfur-free medium; and the other, a sulfur-free medium containing sodium (Na). Three other media were set up containing different sulfur compounds (i.e. sodium sulfate, sodium hyposulfite) at a concentration of .01M. After waiting forty-eight hours, a 50 ml sample of Chlorella was taken every twenty-four hours for fifteen days. The samples were filtered using .045 micron filter paper of constant weight and a Millipore filtering apparatus. Each sample was dried then weighed on an analytical balance. The growth rate of the Chlorella in each medium was compared. Each experimental growth rate showed a linear growth pattern; therefore, a linear regression, an analysis of variance and a mean separation was performed.

#Second Award - General Motors ISEF
Meritorius Award - United States Army

THE EFFECTS OF AN ELECTRIC FIELD ON PLANTS

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This experiment was conducted to investigate the effects of a d.c. electric field on seed germination and growth rate. Seeds were planted in two identical containers with one container placed in the electric field and one used as a control group. Each group was cared for in the same manner and checked daily. After the seeds had sprouted for two weeks, they were dug up, measured and weighed separately.

The procedure was repeated, but the direction of the electric field was reversed. In the first experiment, the positive terminal was connected to the screen above the plants and the negative terminal was connected to the screen below the plants creating a positive electric field. In the second experiment, the electric field was reversed. These two experiments considered togather are referred to as Trial I.

The above experiments were both repeated. Both Trial I and Trial II yielded similar results. It was found that plants sprouted faster and grew 10-20% larger under a positive electric field; and sprouted slower and grew 7-13% less under a negative electric field.

In an attempt to explain these results, the plants in Trial II were dehydrated in an oven for 12 hours and weighed. Results indicated the percentage weight difference between wet and dry plants and their control groups varied. The plants, particularly the stems and leaves of the positive field group, lost more weight. This indicated there were more fluids in the positive field plants.

Therefore, the positive electric field appears to aid the transfer of fluids from the roots to the stems within the plant, while the negative electric field tends to prohibit this fluid movement. This is reasonable since the fluids in plants contain ions.

#ALOE VERA, A PLANT BACTERICIDE, COMBATS CROWN GALL

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Crown gall, induced by Agrobacterium Tumefaciens, devastates the host plant. To broaden the chances for the afflicted plant, a bactericide is applied to gall areas. In vivo and in vitro investigations are conducted.

In vitro investigations are conducted by putting the bactericide on prepared cultures of bacteria three times a week. When compared to cultures of only bacteria, there was a 70% decrease in the number of bacteria in the cultures exposed to the bactericide after 10 days. The bactericide is an ingredient of a fully mature, three year old aloe vera plant.

The in vivo investigation is conducted using a host plant (tomato) inoculated with the bacteria. Tested patterns of wounding and inoculating are used to encourage large tumor growth. A designated group of plants receive a dosage of aloe vera applied to the wound. Four days after inoculation, untreated plants form tiny bumps around the wound. These bumps continue to grow and 50% became large, about 5.5cm and 50% reach about 4.0cm. Plants treated with aloe vera have no bumps on 60% and the remaining 40% of the plants have small tumors only reaching 1.1cm. Tumors are 80% larger on the untreated plants. Continued positive results could lead to new possibilities for plants afflicted with crown gall, a debilitating disease.

#Fourth Award - American Phytopathological Award

#LIMAX MAXIMUS SOIL: ITS EFFECT ON SEED GERMINATION AND PLANT GROWTH

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The purpose of this experiment was to determine the effect of Limax Maximus soil on seed germination and plant growth.

In a previous study, it was learned that Limax Maximus mucus caused chemical and physical changes in the soil. Experimentation and testing revealed that soil texture changed from loam to sandy loam, that the Limax Maximus mucus neutralized acid and alkaline soils in sixteen weeks, and that the absorption of water was slowed by .11 cm. per second due to the presence of Limax Maximus mucus.

The next phase of research involved studying the effect these chemical and physical changes in the soil had on seed germination and plant growth. With the constants being temperature, lighting, and amount of water, six different varieties of seeds were planted in the Limax Maximus soil and in control soil. Test seeds germinated in an average of 3.3 days as compared to 6.1 days for control seeds. Of the 20 seeds of each variety planted, an average of 18.76 seeds germinated in the test soil while an average of 9.66 seeds germinated in control soil. The average height of test plants was 6.5 cm. after 12 days whereas control plants reached an average height of 4.1 cm.

It is therefore obvious that Limax Maximus mucus in the soil has a beneficial effect on seed germination and plant growth.

Publication of this report has been suggested because of the uniqueness and originality of the study.

#Fourth Award - General Motors ISEF

#THE USE OF AUTOFLUORESCENCE IN EVALUATING MYCORRHIZAL INFECTIONS IN SUGAR MAPLES

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The name "mycorrhiza" is given to a beneficial relationship between a fungus and the root of a plant. In this association hyphae from the fungus enter the cortical cells of the root and form organs of three types: vesicles, coils, and arbuscules. The arbuscules of certain species of mycorrhizal grasses were reported to autofluoresce (glow) when viewed under ultraviolet light. This technique has not been applied to mycorrhizal trees. The purpose of this experiment was to determine if mycorrhiza-infected sugar maple seedlings autofluoresce and, if so, to ascertain the cause of the autofluorescence. Roots were viewed under ultraviolet light and areas of intense and dull autofluorescence were removed. The areas of intense autofluorescence theoretically contained arbuscules. The segments were then analysed on a scanning electron microscope. A percentage of infection was determined by dividing the number of organs present into the number of cortical cells in the sample. A mean was then calculated from the twelve samples that were viewed in the autofluorescing and nonfluorescing groups. The results indicate that there is a direct relationship between autofluorescence and the extent of infection; each type of organ exhibited a higher percentage of infection in the autofluorescing samples. Also, the arbuscules appear to be the cause of the autofluorescence; arbuscules were present to a high degree in the autofluorescing samples and were very scarce in the nonfluorescing samples (only one arbuscule was observed in a nonfluorescing segment).

#First Award - Eastnam Kodak Company
Third Award - American Phytopathological Association

#BACTERICIDAL EFFECT AND BIOLOGICAL ASSAYS OF DIFFERENT MARINE ALGAE EXTRACTS

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This study is based on the fact that between the chemical components of the different species of marine algae some may exhibit posible bactericidal properties against some pathogenic bacterias. A study in search of antibiotical or biological bactericide properties in 42 algae extracts were done.

Water and methanol extracts of five algae showed bactericidal action. Freeze dried and fresh algae were used for the extractions. The algae tested were: Bryothamnion triquetrum,Dyctiontacial sp., Halimeda opuntio,Hypnea Musciformes and Polysiphonia subtiggins against E. coli, S. aureus, B. subtillis and P. aeruginosa. Liquid column chromatographies were used for the separation of compounds of the extracts that inhibited the growth of bacteria. A soxhlet extractor was also used for obtaining extracts from algae using methanol as a soluent. Results of algae extracts showing bactericidal action in differents conditions and with different solvents were as follows: B. triquetrum inhibited E. coli, S aureus and P. aeruginosa; Dyctiotacial sp. inhibited S. aureus; H. Musciformes inhibited E. coli; H opuntia inhibited S. aureus and E. coli. An infrared spectrophotometer was used in an attempt to determine some components of compounds separated in L.L.C.C. that shouwed bactericidal action. Tests in TLC plates were done. A standard substance extracted from other marine organism that had anti-mitotic and anti-neoplastic properties was compared with the extracts. The algae B. triquetrum and H. opuntia shouwed positive in the development of mitosis in sea urchin eggs. A test in vivo with these extracts will be done in order to determine its effects in tumor cells.

#Second Award - General Motors ISEF
Honorable Mention - United States Air Force

THE USE OF ELECTROPHORESIS IN DETERMINING PROTEIN DIFFERENCES CAUSED BY MINERAL DEFICIENCIES

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The purpose of this project was to find whether protein differences exist among plants grown in complete, nitrogen deficient, and iron deficient media. Electrophoresis was used to separate and identify the proteins.

150 soybean seeds were grown hyperphonically in complete, nitrogen deficient, and iron deficient media.

Electrophoresis was then used to determine differences, if any, in the leaf proteins among the three groups.

Deficiencies of iron and nitrogen were found to affect plant protein. The deficiencies caused an increase in proteins having a mass greater than 240,000 daltons in both experimental groups. The nitrogen plants showed a 20.15% increase and the iron deficient plants showed a 29.45% increase in these proteins. A possible explanation for the increase in heavy weight proteins in the iron deficient media is that the electron transport chain was altered and therefore heavy weight storage proteins were not being broken down as quickly.

The increase in the nitrogen deficient medium could possibly be due to the plants bonding light weight proteins together into heavier ones.

The above data is further supported by the changes found in the lighter weight proteins, those having a mass less than 100,000 daltons. The nitrogen showed an 89.01% decrease while the iron showed a 60.99% decrease in light weight proteins.

Changes in number of protein bands also supports the above explanation. The nitrogen deficient medium showed an 11.11% increase in heavy weight proteins and the iron deficient medium showed a 48.89% increase.

EFFECTS OF THE INORGANIC COMPONENTS OF THE WHIT'S AND MURASHIGE MEDIUMS WITHOUT EXOGENEUS HOMONES IN CALLUS FORMATION IN GINKGO BILOBA EMBRYOS

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This investigation intends to prove that the production of these callus in the Ginkgo biloba embryo using the White's and Murashige Skoog culture with cotton and parafilm closuree, are inducted by a chemical reaction between the embryo the nutrients of the culture and the parafilm closures. Callus are an abnormal growth of the cells in a plant.

The cultivation methods are those used in the Plant Tissue Culture Technique; modifying some of those techniquesand conducting the incubation at a temperature of 29°C.

In the experimental phase we interchange the Inorganic Salts present in the Whit's medium with those of the Murashige Skoog medium and viceversa. Both experiments were conducted under the same conditions of experimentation and wearing closures of cotton and parafilm properly sterilized.

In my investigation, I found that from all the inorganic salts sed in the Murashige culture the KCL reached a production of 40% of callus with cotton closures and 100% with parafilm closures. Meanwhile in the White's culture we obtained 40% with the cotton closures and 20% with the perafilm closures.

The other compound that was discovered as a great productor of callus was the Ca $(NO_3)_2$. This showed a productuion of 100% of callus in the Marashige culture with parafilm closures and a 20% with those of cotton.

Later experiments show that the producting substance of callus is one wich is formed by the embryo and some other agent of the atmosphere.

#DUTCH ELM DISEASE: DIAGNOSIS AND ENVIRONMENTAL EFFECT

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Dutch Elm Disease is becoming a serious environmental problem affecting elm trees in rural shelter belts, scenic parks, urban home areas, historical land sites, and river beds. It is projected that eventually all native elm trees in the upper midwest and Canada will die of the disease if not controlled. The object of my project is to make the general public and local government aware of the seriousness of Dtuch Elm Disease. Also how to detect and diagnose the disease, and recommend measures to control Dutch Elm Disease.

I went on field trips in Manitoba and North Dakota. I worked at the U. of Manitoba Plant Pathology Lab doing cultures of tree samples for breeding by bark beetles by checking for galleries and larvae mines. I went with sanitation crews to see the effectiveness of tree spray with insecticides for bark beetles and fungicides injected into trees for Dutch Elm Disease.

I have found that Dutch Elm Disease can be controlled by: 1. Having a site inventory of locations of elm trees and areas of Dutch Elm Disease. 2. Laboratory confirmation of Dutch Elm Disease by culturing suspected tree branches. 3. Adequate pruning of infected and dead branches. 4. Improved sanitation by removal of dead and infected trees, cleaning up dead trees along river beds, and removal of bark from elm woodpiles. 5. Injection of fungicides. 6. Spray for beetles. 7. Replace dead elm trees with green ash, evergreens, and other varieties.

#First Award - Eastman Kodak Company

Aerodynamics of the Samara

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Using Maple Samara, I related subtle differences in the seeds with Aerodynamic properties the seeds have. I tested the differences in wing angle and related wing angle with spin frequency and rate of drop. The center of gravity and seed development were also checked and related with the results of the testing. A stroboscope was used to test the spin frequency and to take pictures to show the downward attack angle of the leaf in a semi-measurable form. A flat samara was found to have ideal aerodynamic properties for flight away from the tree. The seed would need to travel away from the tree in order to compete.

Nature's designs have a lot of research to be done to perhaps lend themselves to new designs and new research. Seed dispersal mechanisms have many evolutionary secrets that help us understand the amazing scheme of nature's survival plan.

#ORGANIC AND CHEMICAL AMELIORATION OF COPPER TOXICITY

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Throughout the world there are areas of derelict land where metal toxicity is a major soil factor. The establishment of a vegetative cover on or around the pollution will limit the spread of pollution, improve soil conditions, complex the heavy metal, and reduce the effective concentration. But, the conditions of toxicity, poverty of nutrients, and the physical nature of the material make normal techniques of vegetative establishment impossible. The objective of this research was to determine the tolerance of various plants to a representative heavy metal pollutant, copper (II) sulfate ($CuSO_4$) and to ameliorate adverse responses by the addition of materials.

In root inhibition tests, legumes were moderately to extremely tolerant and could be considered for vegetative cover on copper polluted soils. The toxicity was chemically reduced by carbonate and nitrate salts of (best to least ability): (1) zinc, (2) magnesium, (3) potassium, (4) aluminum, and (5) calcium. However, due to potential toxicity, the use of zinc and aluminum compounds as chemical agents should be restricted.

In pre- and post-emergent tests, the toxicity of $CuSO_4$ was decreased by a "natural" method that involved the use of organic refuse and chemicals found in Kentucky and other environments. The addition of sewage sludge improved conditions by as much as 360%. Copper polluted soils can be organically and chemically ameliorated for vegetative establishment by incorporating the addition of organic refuse (sewage sludge or leaves) with the "liming" of soil using dolomitic limestone or the application of saltpeter.

#First Award - American Society of Agronomy
First Award - United States Air Force
First Award - United States Army

ALLELOPATHY

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Studies were conducted to determine if the common milkweed (Asclepias syrica L.) plant has allelopatnic effects on the germination and plant growth of crop plants.

Germination of Crop Seeds

Milkweed residue was collected and chopped up. Mixed the chopped up residue with distilled water and added a separate crop seed to each petri dish. I used six different milkweed concentrations: 25%, 20%, 15%, 10%, 5%, 0% (control). Crop seeds used were corn (Zea mays L.), oats (Azcra satiza L.), and sorghum (Sorghum bicolor M.).

Growth of Crop Plants

Milkweed residue was chopped up. Mixed the chopped up residue with potting soil by weight. I planted the seeds of different crops in the various milkweed concentrations (same concentration as germination experiment).

Upon review of the data, the following conclusion was drawn. As the concentrations of milkweed increased so did the allelopatnic effects on the growth and germination of all three crop seeds.

#A COMPARATIVE ECOLOGICAL AND TAXONOMICAL STUDY OF GEASTRUM IN THE TEMPERATE BIOME OF NORTH MISSISSIPPI

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Geastrum (from geo=earth and aster=star) or earthstars are among the more common and interesting fungi of Mississippi and are a variety of puffball. Unlike common puffballs, the outer skin splits and unfolds to form a "star".

Geastrum are usually found in yards, pastures, sandy or wooded habitats, and grassy open fields in Mississippi. The most common Geastrum found in Mississippi is the Geaster=Geastrum hygrometricus.

The main purpose of this study is to investigate climatic conditions that influence the distribution, abundance, and locomotion of Geastrum of the Temperate Biome of North Mississippi.

During the investigative period specimens were found and classified. Later the Geastrum were placed in environmental boxes. There growth took place. After one month in the environmental boxes the Geastrum were placed in a wet-dry cycle box, where locomotion took place.

Tests and results show that the abundance, quantity, and locomotion of Geastrum varies according to the relative humidity and the environmental temperatures.

#Fourth Award - General Motors ISEF

#STUDY OF PLANT EXTRACTS OF THE FAMILY SOLANACEA IN TEN SPECIES OF HARMFUL INSECTS

Cruz Ramírez, Pascual, Lola R. de Tio H. S., San Germán, P.R. 00753;
Barrio Cain Bajo, Carr. 119, Km. 3.9, San Germán, P. R. 00753.

This investigation attempts to find an insecticide that will not pollute waters and will not affect man. It also aims to find a use for members of the Solanacea family which are considered as weeds. The family was selected since our foklore indicates they are used to kill insects. Fifteen species have been used: Solanum torvum, S. caribaeum, S. ciliatum, S. auriculatum, S. dulcamora, Capsicum frutescens, C. baccatum, Datura stramonium, D. mollis, D. suaveolens, Nicotiana tabacum, Brunfelsia undulata, Lycopersicun esculetum, Solandra longiflora and Physalis angulata.

Water extracts have been tested against 10 species of harmful insects with the first seven plants. Extracts were made of flowers, fruits and leaves. Extracts were applied with a spray bottle to 10 insects of each species. Observations were made from 10 to 10 seconds; 2 minutes, 1/2 hour 2, 4, 12 and 24 hours. The least resistant insect was Selenothrips rubrocinctus. Resistant insects were Phyllophaga vandinei and Periplaneta americana. Most effective plants were: S. torvum (fruit), C. frutescens (fruit), D. suaveolans (flower), N. tabacum; (leaf), D. stramonium (fruit and L. esculentum (fruit and leaf). Methanol extracts were also tested againsts all species of insects considerably reducing the time of death. Methanol extracts of flower, fruits and leaves were separated via thin layer chromatography using a 5:1 mixture of chloroform and methanol as the solvent. Best separation was obtained for the leaf of S. torvum, with 6 spots. Spot number 5 showed some activity. Fractional destillation is in progress.

#First Award - American Veterinary Medical Association

#AN INVESTIGATION OF THE OSAGE ORANGE FRUIT (MACLURA POMIFERA) AS A SOURCE OF PROTEOLYTIC ENZYMES (POMIFERIN)

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This investigation was designed to determine the potential use of Osage Orange (Maclura pomifera), commonly known as hedge apples, as a source of proteolytic enzymes for food industry. Proteolytic enzymes are agents which break down proteins into peptides or amino acids. A steady increase in the demand for a variety of proteolytic enzymes is projected by the food industry because of the need for modifying a number of food proteins enzymatically, either to increase solubility or to improve textural properties. However, needed enzymes are presently an expensive commodity and the supply is limited.

My procedure was first to determine the toxicity of the fruit. The mixture was injected into selected groups of animal life. Preliminary tests were conducted to determine the general food value. The presence of strong proteolytic enzymes in Osage Orange was demonstrated by adding a few drops of water extract from the fresh fruit onto whole and skim milk. Purification, concentration, clotting and exact activation exhibited by the Osage Orange were also determined.

I have calculated from these results that there are sufficient enzymes in a small fruit of about 175 grams to firmly coagulate 1,000 liters of milk at 37°C in 30 minutes. This amount of enzyme activity is large enough to warrant commercial exploitation of the Osage Orange as a source of proteolytic enzymes.

#Third Award - General Motors ISEF

#A STUDY OF THE ALLELOPATHIC POTENTIAL AND INHIBITORY EFFECTS OF CAJANUS CAJAN (L.) MILLSP. TOWARDS THE GERMINATION AND SEEDLING GROWTH OF SOME PLANTS.

Pérez, Roberto, Colegio San José, San Germán, P.R. 00753;
Urb. Porta Coeli B-8, San Germán, P.R. 00753.

The pigeonpea is a tropical legume used for grain, fresh peas, or as a forage. Pigeonpeas are popularly known for their weed suppression traits. Rice (1948) suggested the release of phytotoxic metabolites by the crop plant (allelopathy), as a possible mechanism for said suppression. When they are absorbed onto surrounding soil surfaces, they suppress the seedlings of many species in the area.

In Puerto Rico the pigeonpeas represent to the farmer a big problem. The residues that are released by the pigeonpeas affect future crops. I feel that self-inhibition of pigeonpeas may be responsible for the decline of pigeonpeas in coastal areas of Puerto Rico where they were produced in continous culture. In Puerto Rico survey of production fields have shown few nematodes and rot problem as little response to fertilizer problem to account for yield decline.

The growth of white beans under the influence of dry pigeonpea leaves produce malformation in the plants, lack of nutrients and distortion in the shoots. The rate of transpiration and biomass of these plants are less than those not exposed to high percent of leaves. Germination test using non-volatile substances and fresh leaves demonstrate great inhibition power to principal and secondary roots. Volatile substances act more severely to plant height. Suspected glands are found in both ventral and dorsal side of the leaves. White beans and tomato seeds exposed to soil affected by pigeonpeas germinate at a lower rate than those in control soil. Identification of weeds under pigeonpeas were made, and all demonstrate capacity to resist dry soil.

#First Award - American Society of Agronomy
Honorable Mention - Eastman Kodak Company

THE EFFECTS OF VERTICAL AND LATERAL GEOTROPISM VERSUS PHOTOTROPISM

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This project focuses on the effects of vertical and lateral geotropism versus phototropism. The purpose for conducting these experiments was to discover exactly what effect geotropism had on the stem and root systems of plants and how the addition of phototropic stimili would change these effects.

Four klinostats were set up to create geotropic forces. Two of the four rotated vertically and two rotated laterally. A light was placed on one klinostat of each type to produce phototropism and counterbalance the effects of the geotropism. This sets up four individual tests.

Lateral geotropism: the stems grew upward away from the source and then outward; this is a completely geotropic response. Lateral geotropism with phototropism: the stems grew away from the source, outward, and then turned toward the light located at the center of the klinostat; the resulting s-shaped stems demonstrate the characteristics of both lateral geotropism and phototropism. Vertical geotropism: the stems grew first outward and then upward; this is a purely vertical geotropic response. Vertical geotropism with phototropism: the stems grew outward, upward, and then grew back towards the light; the resulting u-shaped stems indicate the presence of both vertical geotropism and phototropism. The roots of the control group were dispersed evenly about the stem and were well-established, whereas the roots of the test plants tended to grow in the opposite direction as the stems did and were poorly developed. The stems of the plants exposed to geotropism grew at an increased rate compared to that of the control group.

WHAT IS THE EFFECT OF VARIOUS SOUND FREQUENCIES ON THE GROWTH AND GERMINATION OF MONOCOTYLEDONS AND DICOTYLEDONS?

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The purpose of these experiments is to find out if monocotyledons and dicotyledons will germinate and grow better if exposed to various sound frequencies.

First, one piece of filter paper was placed in eighteen containers where four corn seeds and bean seeds were placed. Next, two petunias and two onions were placed in eighteen pots. Then a teaspoon of distilled water was placed in each container and the containers were covered. Two teaspoons of distilled water were placed in each pot. Next, the pots and containers were divided up into nine groups with a corn, bean, petunia and an onion in each group. For fifteen minutes every twenty-four hours each group listened to their specific frequency. Measurements were taken weekly for four weeks.

My hypothesis for these experiments is that the seeds and plants exposed to the sound frequencies will grow the best.

My conclusions drawn from these experiments were that the seeds and plants in the groups exposed to the sound frequencies grew the best. However, the one-thousand (1,000) frequency group grew better than the other groups.

The results from these experiments are useful to anyone who wants to sprout seeds quickly before bacteria or insects get to them. These results are also useful to people who live near a very secluded or busy area, so they may know just exactly how low and high frequencies can effect the germination and growth of the plants they are growing.

EFFECTS OF AUXINS ON CLONING ST. PAULIA IONANTHA

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The PURPOSE of this project was to confirm the HYPOTHESIS that plant auxins will stimulate the cloning process of St.Paulia ionantha. The first step of the PROCEDURE was to place a healthy leaf into a 10% solution of sodium hypochlorite and a 40% solution of ethyl alcohol for six-minute periods. The excised leaf was transferred into a sterile petri dish and cut into 4 mm sections, making sure that each section included a portion of the vein. The explants were then inserted vertically into stem multiplication medium. The control media contained 6,12 and 18 drops of distilled water while the various experimental media contained 6,12, and 18 drops of either gibberellic acid, indole-3-acetic acid, or naphthaleneacetic acid. The developing plantlets were broken up and transferred into root multiplication media which included additives identical to those of the stem multiplication media. When the root systems were large enough, the small plants were potted in a sterile potting medium. OBSERVATIONS: In 35 days the explants first produced primordia-producing calluses. Tabulations of the numbers of these calluses revealed that the reproductive capacity increased 37% with 6-drop additions of gibberellic acid and increased 23% with 12-drop additions of indole-3-acetic acid. Naphthaleneacetic acid did not appreciably increase numbers of primordia. Gibberellic acid and indole-3-acetic acid plant cultures also produced larger plantlets with more extensive root systems after being removed from the stem multiplication medium. CONCLUSIONS indicate that supplements of the auxins, gibberellic acid and indole-3-acetic acid substantially increased the cloning capacity of St. Paulia ionantha, providing they are administered in correct amounts.

Circadian Rhythms

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Purpose/Application: The developement of a technique, using colored light variations and time changes (light vs. dark), to enable the researcher to distinguish the amount of growth which occured during the given experiment. Some of the possible uses of the studies from the experiment would be; to increase or decrease the growth rates of agricultural products and to neutralize bacterial growth harmful to this fungi.

Hypothesis: The researcher will be able to control growth rates of fungi and tell age of fungi without the use of dates as to when fungi was cultured.

Procedure: Methods used during the course of research include, Making of P.D.A. (Potato Dextrose Auger),culturing the fungi, placing fungi under different colored lights and time variations, and collecting data includes: measuring fungi, color variations of fungi, resistance to a form of bacteria.

Conclusion: The fungi will develope two different types of rings. One is the vegetation and the other is the reproductive part of fungi. The growth rate of the fungi can be controlled bo the different colored lights. The fungi can neutralized a certain bacteria and still continue growth rate.

EFFECTS OF HOUSEHOLD SUBSTANCES ON LONGEVITY OF CUT FLOWERS

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The purpose of my study was to determine the effects of household substances on the longevity of cut flowers. In Experiment I, I tested the effects of aqueous solutions containing bleach, coke, aspirin, and fresca on the life span of carnations, chrysanthemums, and marguerita daisies. This group was my experimental group. The control group involved the use of the same flowers placed in plain tap water. I conducted the tests at room temperature. My results indicated that bleach was the most effective household substance tested, with fresca providing the least effective results. Because of the results obtained from Experiment I, I wanted to discover a scientific explanation to support my results.

In Experiment II, I devised an aseptic method of testing based on Koch's Postulates to determine if the flower deterioration was bacteria related, which could provide for a correlation between the specific bacteria and the household substance tested. The results of these tests indicated that bacteria was not the major factor in varying the longevity of cut flowers.

Since all of the household substances tested are acidic in nature, I developed Experiment III to determine if the pH of the substances tested affects the longevity of cut flowers. The results of these tests strongly indicate the pH is the major factor that affects the longevity of cut flowers.

#TOXIN PRODUCTION AND CULTURAL AND MORPHOLOGICAL CHANGES IN *HELMINTHOSPORIUM VICTORIAE* GROWN ON DIFFERENT NITROGEN SOURCES

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This project involved a pathological study of a toxin producing fungus, *Helminthosporium victoriae*.

The purposes of this experiment were to discover the effect that different nitrogen sources have on the growth (cultural and morphological changes) of the fungus, *H. victoriae*, in vitro and to determine the relative amount or potency of the toxin produced by this fungus-grown in liquid Czapek's medium.

The fungus, *H. victoriae*, was transferred from a culture of *Helminthosporium victoriae*, to flasks containing liquid Czapek's medium. Each of the following nitrogen sources were substituted in the medium for the standard nitrogen source, Sodium Nitrate: Sodium Nitrite, Potassium Nitrate, Ammonium Sulfate, and Asparagine. An 18 day time period was alotted for growth. During this time period, cultural and morphological changes of the fungus were observed. The fungus did show a visible difference in growth rate, growth patterns, and the structure. After an 18 day growth period transpired, the toxin produced by the fungus in the mediums was extracted. The toxic liquid was transferred into several petri dishes containing potato dextrose agar. Following this procedure, sterile susceptible and resistant oat seeds were then transferred to the petri dishes. Germination counts began on the third day and records were kept until day eight. Root and shoot lengths were also recorded at this time. The results from this experiment show that different nitrogen sources do have an effect on the amount or potency of the toxin produced by the fungus, *H. victoriae*, indicated by root and shoot lengths.

#Second Award - United States Navy
Third Award - General Motors ISEF

EFFECTS OF INDUSTRIAL X-RADIATION AND ULTRASOUND APPLICATION ON PLANT GROWTH

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For 3 years, this experiment has investigated the effects of x-radiation on plant growth to find a point where complete growth retardation occurs. Phase I investigated the effects of a dental x-ray machine on 6 types of seeds at various time exposures. The results indicated that plant growth was both stimulated & retarded; stimulation at the shortest time exposure & retardation at the higher exposures. Wet seeds were less affected by the radiation than dry seeds. Oat seeds were found to be the hardiest.

Phase II investigated only oat seeds because of Phase I results; the growth rate indicated retardation when exposed to the x-rays from a physician's x-ray machine. As a comparison, an electrical current was used which also slowed down the plant growth.

Phase III used an industrial x-ray machine & ultrasound equipment to determine their effects on oat seeds. A total of 700 seeds were radiated at 3 time exposures & 100 seeds were used as the control. All time exposures of the industrial machine retarded the growth. However, the ultrasound machine stimulated growth.

From 3 years of testing it can be concluded that low dosages of radiation at short time intervals have an apparent beneficial effect on seeds. As the levels of radiation increased & time exposure increased, the growth rate decreased almost to the point that no growth at all occurs.

THE EFFECT OF FERTILIZERS ON THE GROWTH OF *VIOLA WITTROCKIANA*

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I designed an experiment to find out what is in a fertilizer that stimulates or controls the synthesis of proteins and carbohydrates, which in turn control the growth of *Viola wittrockiana*. I tested fourteen *Viola wittrockiana* seedlings over a period of eight weeks. My selection of fertilizers included: *Bonemeal*, a dry, incomplete, organic fertilizer; Fish Emulsion, liquid water soluble, complete, organic; *Spoon-It*, dry water soluble, complete, synthetic; *Plant Food for Blooms and Buds*, liquid water soluble, incomplete, synthetic; *Jobe's Plant Food Spikes*, spike, complete, synthetic; and *Ortho Gro Liquid Plant Food*, liquid water soluble, complete, synthetic. I used two plants to test each fertilizer, and two were used as a control.

My hypothesis were: 1) If a fertilizer was given properly, then the plant would show more leaf and stem growth and bloom output than the control. 2) If a fertilizer has high and proportionally close percentages of the three primary elements nitrogen, phosphorus and potassium, then there would be more leaf and stem growth and bloom output than the control or a fertilizer with a low percentage of the primary elements or a wide fluctuation in their percents. 3) If a water soluble fertilizer was applied, then the stem and leaves would grow faster than the plants that had a dry non-water soluble fertilizer.

My hypothesis were correct in that nitrogen, phosphorus and potassium are the elements in fertilizers that control growth. Bloom output though is not controlled by them.

EFFECTS OF THE PLACEMENT OF FERTILIZER IN RELATION TO THE SEED AT DIFFERENT SEEDING DEPTHS

Verwest, Lisa J., Finley-Sharon H.S., Finley, ND 58230
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Farmers plant wheat at various depths with or without fertilizer placed near or beside the seed. The purpose of my experiment was to find the best seeding depth and fertilizer placement combination for good plant development. Black loam soil was used, into which I placed granules of the following fertilizers-nitrogen, phosphorus and potassium. To conduct my experiment I had ten small test plots. It took three days for the seeds to germinate and five days for the first leaf to appear above the soil. A daily germination check and an average vegetative growth measurement was taken from the fourth to the fourteenth day. At the end of the first week, I opened up one group of test boxes and checked the plant development. After the second week I opened up the remaining group of test boxes (five boxes) and collected the data.

I conducted a similar experiment using ten test plots to confirm the results. I seeded just the optimum depth found in my first experiment and placed the fertilizer at various depths.

My experiments showed the most desirable planting depth of the seed was one inch below the soil surface. I proved the most favorable placement of the fertilizer to be two inches below the seed.

#LICHENS: NEW METHODS OF DETECTING AIR POLLUTION BY ANALYZING THE PHYSICAL AND CHEMICAL CHARACTERISTICS OF INDIVIDUAL SPECIES

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The purpose of this research is to see how the physical and chemical characteristics of the individual lichen species are affected by hydrogen sulfide air contamination produced by increased oil activity.

In previous experiments, the results indicated that the environment was more acidic in the increased oil and gas activity area. In continuing the experiments, individual species of lichens were tested. This was done by comparing the species. The algae content, size, pH, sulfate and the amino acid content of each species were also studied. The lichens were collected from three sites that were selected according to the relative amounts of oil and gas activity.

In continuing experimentation over a two year period, it was found that four of the six species were similarily affected. The algae counts were lower, size was smaller, pH was more acidic, the sulfate content was higher and amino acids were less numerous in the lichens collected from the area of highest degree of oil development. The fifth and sixth species, Physcia aipolia and Physcia adscendens, showed, with the exception of a lower pH, that they were not adversely affected by the increased oil and gas activity.

Based on the experimentation done, it was concluded that the physical and chemical characteristics of individual lichen species were noticeably affected by the increased oil and gas development, therefore any of these methods could be used as an effective way to detect air pollution.

#Alternate Award - U.S. Department of Energy

WATER HYACINTHS - POSSIBLE INDUSTRY IN PUERTO RICO

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Due to the fast proliferation of Water Hyacinths in the rivers and lakes of Puerto Rico and the problem posed by it, I started to look for a solution by the elimination of the same while using it for the benefit of the community.

Considering the energy crisis affecting our economy and taking into consideration the protein and aminoacids content of the Water Hyacinths, I decided to study the possibility of using these plants as a fertilizer and as a source of energy. The experiment was directed towards the production of methane gas through decomposition process of Water Hyacinths.

For my experiment I designed a machine which turns the Water Hyacinths into methane gas and the residual material becomes a fertilizer. The gas is eliminated in the process through a valve installed in the machine. The fertilizer is the result of the cutting of the leaves with a spiral spring installed in the machine.

ECOLOGICIAL, CHEMICAL AND BACTERIOLOGICAL RESEARCH OF ALGAE AND ITS POSSIBLE USE FOR SKIN ILLNESS TREATMENT

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In 1980, we started researching on seaweed (algae) information. We made an ecological research in the cost of Dorado, P.R. to determine the most abundant algae in that zone so as to use it in our research. The most common seaweeds (algae) were Sargassum sp. Caulerpa and Rhodimenia. We gathered one pound each of sargassum sp. and Rhodimenia to make a complete analysis of their minerals and nutrients. The results demonstrated that they contained a great amount of mineral and nutrients such as Potasium, Iron, Niacin, etc. The literature in various sources of information indicated that algae (seaweed)contained antibiotics. On the bases of this information we made the investigation comparing various antibiotics such as Penicillin with algae antibiotics concerning common bacterias. The algae (seaweed) antibiotic produced same results as that of the common antibiotics. After these results, we prepared an algae ointment with purified chemical water to treat common skin illness. This ointment was applied to a patient with fungus in his hands. In several weeks the fungus had disappeared. Vulgaris Acne was also treated. Although the Acne had not disappeared completely, it could be observe that it had been controlled and started to disappear.

After demonstrating that algae (seaweed) can be used as a medicine for skin illness, we tried to use it as an insecticide. We put various arachnids in research tubes and moisten them with algae liquids. The arachnid died in five minutes.

#DETERMINATION OF PORE SIZE OF PLANT CELL WALLS

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The purpose of this research was to become familiar with plant tissue culture techniques, determine the pore size of the plant cell walls, and to establish suspension cultures that would enable cloning of the carrot plant, Daucus carota.

Carrot seedlings were grown under sterile conditions. After growth, hypocotyl sections were excised and disinfected. These sections were then placed in culture tubes and produced into callus pieces. Callus tissues were subjected to dichlorophenoxyacetic acid (2-4D) and then used to establish suspension cultures in Gamborg, Miller and Ojima salt base supplemented with thiamine HCl, pyridoxine and nictotinic acid. Cells from the suspension cultures were subjected to compounds of Polyethylene Glygol of various molecular weights and known molecular diameters. Cells were observed for plasmolysis and cytorrhysis through a phase contrast microscope. By knowing molecular sizes which were able to penetrate the cell wall and those excluded, a determination of pore size range was made.

Actively dividing viable cells of Daucus carota were successfully established in vitro. It is concluded that an approximation of pore size can be made by detecting plasmolysis or cytorrhysis in a cell culture subjected to known molecular diameters. Cell plating was also successfully accomplished from the suspension cultures.

#Third Award - General Motors ISEF

#EFFECTS OF HUMIDITY ON THE DISCHARGE OF SPORANGIA IN THE PILOBOLUS FUNGUS

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The purpose of this research was to determine whether or not humidity has a significant effect on the discharge of sporangia in the Pilobolus fungus. Controlled humidity chambers were constructed and used to expose cultures of Pilobolus to three different humidity ranges (32-37%; 62-67%; 92-99%) within a time frame of fourteen hours. The results indicated that maximum sporangial discharge can be readily achieved in Pilobolus cultures by exposure to relatively high humidities. This suggests that increased atmospheric humidity increases the cell's tendency to absorb water, thus increasing the pressure contained within the subsporangial vesicle, and ultimately increases the number of sporangia discharged. These results would also account for its presence in a moisture-rich medium such as fresh horse dung.

#Fourth Award - General Motors ISEF

#THE MASS CULTURE OF ALGAE

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An effort has been made to solve the primary problem of algal mass culture, that of light saturation. A culture device based on a concept developed in this study was designed and constructed. Although the basic principle was proven, its application to large scale algal culture was rejected for several reasons. The research with this concept has led to the proposal of a more practical solution to light saturation. Several other developments with possible benefits for mass culturing algae resulted from this study.

An effort was also made to collect data, by litery research, surveys, and experiments, on the utilization of algae. As a result of this study, data was obtained documenting the human bias toward algal food, and algal feeding trial was completed, and several conclusions were made relative to algal utilization.

#Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Second Award - United States Air Force

GERMINATION STUDIES WITH XANTHIUM STRUMARIUM

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Xanthium Strumarium (cocklebur) has a bi-chambered seed. One seed typically germinates in the middle of spring and the plant grows, flowers and fruits early in the growing season. The other seed germinates in mid summer. The plant flowers and fruits as the days shorten in the fall, Xanthium being a short day plant. Thus we see from the same bur, cockleburs produce two crops a year.

This investigation was to determine the mechanism of differential seed germination in cockleburs.

The possibilities of hard seed coat, chemical inhibition, lack of oxygen, immaturity of one seed, water impermiability of one chamber and, or a combination of the above factors were examined.

CABIN DENDROCHRONOLOGY

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Dendrochronology is defined as the study of the chronological sequence of annual growth rings in trees.

The objective of this research was to ascertain whether or not log cabin structures can be dated by means of tree rings. Assuming a tree was cut down, in order to construct a cabin, its last tree ring should provide a positive date as to the age of the structure.

This research proved to be an accurate process, assuming that you use the exact ring pattern for every tree specimen the dates should match to within one or two years.

Because tree ring dating simply assigns a calendar year to the formation of a growth ring within a tree, the dating of any other event in relation to that tree ring will always be an interpretive process and must be done in conjunction with additional evidence.

#MORPHOLOGICAL ADAPTATIONS OF THE LICHEN *XANTHOPARMELIA CUMBERLANDIA* IN VARYING HABITATS

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The purpose of this research was to determine if morphological differences occur in the thicknesses of various layers of lichen thalli, *Xanthoparmelia cumberlandia*, at different altitudes and exposures. Thalli were collected at different altitudes and exposures, sectioned, and observed. Thalli layers were measured and the number of algal cells counted. *Xanthoparmelia cumberlandia* appears to have evolved mechanisms for water conservation. They include a thicker upper cortex which reduces water loss and a thicker medulla which stores water that may help ensure a greater chance of survival over extended drought periods. Larger numbers of algal cells in thalli at lower altitudes and/or on surfaces with greater exposure to the sun and high temperatures may be responsible for the increase in the thickness of various thallus layers. Therefore, the greater numbers of algal cells provide more food for the fungus host which in turn provides greater protection for the algal cells, an apparent example of mutualism.

#First Award - General Motors ISEF

TWO YEAR STUDY OF FACTORS AFFECTING CHLOROPLAST MIGRATION WITHIN PLANT CELLS

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Different qualities of light affect plant functions and processes in various manners. With intensity and energy constant, I varied the wavelengths of light and studied differences in chloroplast position in aquatic plant cells.

Chloroplasts assume certain positions in different wavelengths of light. This response may increase light absorption and photosynthesis. I tested responses of three aquatic plants and two types of algae in white (visible), blue (450 nm), and red (650 nm) light. I covered test tubes containing the plants with filters to achieve different wavelengths. I tested the effect of light on cytoplasm and the movement mechanism's control by centrifuging the plant after irradiation.

The chloroplasts are fairly evenly scattered in white light. After centrifugation, several groups of chloroplasts gathered across the cell, indicating that though some resistance exists in white light the chloroplasts are able to move rather freely. In blue light, the scattering is more evenly distributed. The chloroplasts are able to move freely as indicated by large groups at the end of the cell after centrifugation. In red light, clumping and layering along the cell walls are apparent. This is probably a protective measure. Centrifugation indicates chloroplasts meet much resistance in red light. By exposing more surface area to light, as in blue light, more absorption is probable. The active substance is possibly a photorecepter, flavin for blue light and phytochrome for red, which oxidizes and activates the movement mechanism. Actomyosin microtubules are believed to form to regulate movement.

#AN ANALYSIS OF BIO-PHYSICAL PHENOMENA: THE EFFECT OF HIGH-ENERGY ELECTRONS ON PRIMROSE LADY MARIGOLDS

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The purpose of the project is to determine the effects radiation has on ornamental plants.

Primrose Lady marigold seeds were exposed to high-energy electrons varying from 1,000 to 1,000,000 rems. There were eighteen seeds in each of fourteen categories, including two controls. Temperature, and the amount of light and water received by each plant were held constant in an attempt to isolate the variable. The mean, variance and standard deviation of plant growth in each group were calculated by a computer program. An analysis of variance and Duncan's multiple range test were computed by hand to determine which differences in the mean heights were significant. The probability that a plant will die was determined through Calculus, and plant growth was graphed in various ways.

A significant difference was found between most means and the 2,000 rem group had the highest mean growth. A mutation that behaved like a tree grew in the 300,000 rem group. The 2,000 rem group seemed healthier than the other groups; it was also the only group to develop flowers, although they were sterile.

It seems that radiation helps plant growth up to a certain threshold, perhaps because it kills bacteria. The results suggest that 2,000 rems is the optimal level of radiation for marigolds. A threshold for death from radiation exposure is somewhere between 500,000 and 1,000,000 rems. It can be said with 99% accuracy that exposure to high-energy electrons has a significant effect on the growth of Primrose Lady marigolds.

#Third Award - General Motors ISEF

MEDICINE AND HEALTH

DESIGN AND CONSTRUCTION OF AN AUTOMATIC CARDIAC DEFIBRILLATOR

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The purpose of this project was to determine the viability of a cardiac defibrillation unit which would be activated by a cardiac monitoring unit in the event of heart failure or fibrillation. After researching the topic and ascertaining that such a device would be not only plausible, but potentially beneficial in clinical situations, I proceeded to design the appropriate circuitry and construct a working prototype of the device. A relatively simple circuit was designed to generate and dissipate the defibrillating current. Using two 4700 microfarad capacitors, this circuit develops approximately 200 watt-seconds of power at 178 volts from a primary power source of 36 volts DC. The defibrillating unit is controlled by a separate cardiac monitoring circuit of my own design. This monitoring unit uses a 2 inch diameter metal plate to collect the minute voltage produced by normal heart activity. In the absence of this voltage, the defibrillator is activated by the monitoring unit and delivers a single defibrillating shock of 1/100 of a second duration. As a result of my research and work with the circuit, I determined that the theory of automatic cardiac defibrillation can, in fact, be implemented in a clinical situation under the supervision of a physician, with an effective time savings of in excess of two minutes under the average response time of a normal hospital cardiac team.

#THE EFFECTS OF ALCOHOL ON FANCY HAMSTERS' PREGNANCIES

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HYPOTHESIS: After impregnation, the subjection of alcohol will cause the following:

1. The interference of alcohol and amino acids across the intestinal mucosa and the placenta makes the utilization of some nutrients obsolete to the fetus as well as the mother.
2. Faciliated Diffusion. The cytochrome P450 diffuses oxygen over the placenta , and a partial function is to oxidize toxic substances such as ethanol. Oxidation causes 80% of oxygen carried by P450 to be depleted from diffusion.

PURPOSE: The purpose of this pilot study was to show the various effects of ethanol and to develop the first series of abnormalities and malformations of the Fancy Hamsters for the fetal alcohol syndrome research.

PROCEDURE: Four female and five male hamsters were obtained. Alochol preference tests in the fifth male indicated wine was to be used. The animals were divided into groups and exposed to various levels of alcohol.

OBSERVATIONS: Deficiencies were observed in weight, body, length, tail length. Abnormalities appeared in rib spacing, backbone structure, appendage size, foreleg joints, skin conditions, liver and microcephaly was found.

CONCLUSION: From these experiments it is possible to conclude that various levels of alcohol have adverse effects on the Fancy Hamster fetus. The fetal alcohol syndrome can be identified, but only after tests have found several abnormalities and malformations. Liquid diet controlled deficiencies in the mother, but deficiencies were not controlled in the offspring.

#Merit Award - American Medical Association

#THE DEVELOPMENT OF AN EFFICIENT METHOD FOR DIAGNOSING PERIODONTAL DISEASE

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Periodontitis occurs in localized areas of the dentition in a random fashion indicating a random-burst hypothesis. Since likely suspects contributing to periodontal disease include *actino bacillus*, *capmocytophyga*, *Bacteroides*, *Eikenella*, and *Wollenella* species, each was isolated and utilized in this study.

The likehood that a particular molar will be affected by periodontal pathogens depends upon the presence or absence of natural inhibitors. The purpose of this study was to develop an efficient method for diagnosing individuals who are prone to infection by periodontal pathogens. The screening technique initially involved establishing conditions best suited for determining preferred lawn dilution, growth medium, dispensing innoculum, and adequate growth conditions.

An *in vitro* study was conducted in which plaque samples were collected from healthy and acute periodontal patients. By stabbing into periodontal pathogenic lawns, the samples were assayed for their ability to inhibit the periodontal pathogens. An *in vivo* study, involving 24 *mus-musculus* (12 experimental) was then performed utilizing the method developed in the *in vitro* study. The experimental group was monoinfected with *actino bacillus*, the pathogen most prominent with periodontitis. After experimentation, samples were collected from the gingival line of the *mus-musculus* and assayed as in the *in vitro*.

The results from the *in vivo* study indicate that samples isolated from normal patients inhibited each pathogen on a 98% average. The plaque samples isolated from acute periodontal patients failed to inhibit any of the pathogens. The *in vitro* study confirmed the feasibility of the developed method which appears well suited for periodontitis diagnosis.

#First Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Second Award - United States Air Force
Honorable Mention - American Patent Law Association
Honorable Mention - Eastman Kodak Company
Fourth Award - General Motors ISEF

AIR POLLUTION FROM CIGARETTES: A BIOLOGICAL AND CHEMICAL APPROACH

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The purpose of my project was to show biologically and chemically how cigarettes contribute to air pollution, comparing four major brands on the market. Fifteen tests were run to determine air pollution in cigarettes: particulate and tar count, efficiency of filter tips, total intake of pollutants, sulfur oxides, atmospheric oxidants, acidic air pollutants, bacteria count in cigarettes and cigarette smoke, effects of tar and smoke on plants, insecticide from particulate matter, and effects of carbon monoxide on fish and blood.

The particulate count in all four brands of 100's cigarettes is very high. Light 100's and 100's showed a high level of tar. The regular size and 100's have large amounts of sulfur oxides. Ultra, Light 100's, and regular cigarettes affect plants by their smoke. The tar of each cigarette had no effect on plants. The 100's and Light 100's affected the insects the most; a high bacteria count was recorded in Kools; Winston smoke had the lowest bacteria count. The 100's have the most bacteria in the cigarette while Winstons have the least. The effects of carbon monoxide, acidic air pollutants, and atmospheric oxidants were so slight they could not be determined.

Cigarettes cause air pollution biologically as evidenced by their bacteria content and effects on plants and insects, and chemically by the amount of tar, particulates, carbon monoxide, and sulfur oxides contained.

#STUDY IN VITRO ON THE EFFECTS OF THE COMPONENTS OF THE PLANTAGO-GINIS IN MALIGNANT TUMORS (CANCERS)

Adrian Díaz Ruiz-Colegio Santiago Apostol, Fajardo, P. R.
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The objective of this investigation was to utilize the active component and the elixir from the leave of the Plantago-ginis for the control or cure of cancer. For the Phase I, I used twenty white rats of the mus-musculus species. Sixteen were infected with ten cancerous cells of the Erlich Hicilte Tumor, four were not infected. Ten of them were used as a control group (six male and female without treatment, two normal rats[1] with treatment, two normal rats[1]).

After the elixir was obtained by the distillation process, it was applied in oral form to ten of the rats[1] (5 male, 5 female). To observe the development or inhibition of the tumor, various aspects were considered: the weight, behavior, hemoglobin, white blood cells, red blood cells, etc. These aspects maintained normal the treated rats[1] while the control group died, except the four not infected.

In the Phase II the active component of the Plantago-ginis was applied in intravenous form to another group of rats (distributed and classified as Phase I) with the same cancer cells. Also, the same aspects of Phase I were considered to observe the recuperation or inhibition of the cancer. These aspects were maintained higher than in the first group of rats[1] (Phase I). The investigation revealed that the active component of the Plantago-ginis' leave (carboxylic acid) was effective in the control of cancer cells of the Erlich Hicilte Tumor in rats[1].

Therefore, I considered this medicinal plant a great alternative in the control of cancer.

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[1] White rats - used by scientists for medical experiments.

#First Award - American Veterinary Medical Association

THE VARIANCE BETWEEN CAPILLARY AND VENOUS PLASMA GLUCOSE LEVELS

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The intent of this study was to determine whether levels in capillary and venous plasma are equivalent during the administration of fasting and two hour postprandial plasma glucose tests. This study concerned twenty-six subjects, each participating in fasting venous and capillary specimen collecting, consumption of an 800 gram carbohydrate meal, and two hour postprandial specimen collecting of venous and capillary samples. The results from these tests averaged a 6 gm/dl. or 6.4% variance during fasting testing and 15.3 gm/dl. or 16.0% variance during two hour postprandial testing. Capillary findings with this large variance could cause false diagnosis of diabetes, or hypoglycemic diagnosis to be overlooked. Weight per inch plays a role in determining the amount of variance, large weight per inch levels have very low or even opposite variance reactions. Considering two hour postprandial findings variances decrease as weight per inch increases. With an increasing number gm./dl/ % variance decreases. This leaves hypoglycemic levels having the highest amount of variance which makes these levels difficult to determine. The range where transition between normal and diabetic levels is determined also is under a rather high % of variance.

The results make it difficult to ignore the possible effects of specimen collection on valid evaluation of plasma glucose findings.

LOCAL ANESTHETIC EFFECT PRODUCED BY SALMEA SCANDENS ROOTS SOLUTION

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The main purpose of this project is the determination of the medical anesthetic action of the suspensions obtained from the roots of the Salmea Scandens plant. The procedures used to obtain our purpose was based upon the use of extraction techniques, chemical mechanisms, classical chromotographics, and the analysis of the processes from a bioclinic perspective.
The suspension applied to different experimental procedures (as the differential dosages of the extract in Lumbricus Terrestris and the measure of its deffensive reflexes; the sensibility tests made in Oryetolagus Cuniculus who received different subcutaneous dosage; the tolerance tests and the reaction to the anesthetic substance in humans) show the anesthetic action of the Salmea Scandens and stresses its activity in dissolutions at cold temperatures. It also shows that the active ingredient of the plant is very volatile, with reversible action and with minimum toxification.
The biochemical fundaments of the substance tend to show the presence of functional complex units as are the alcaloids in conjunction with the terpenes and phenols. This picture applied to the experimental processes carried on in organisms with less or more structural and functional complexity (in terms of subcutaneous infiltrations and applications) shows that this active anesthetic ingredient of the plant has a temporary inhibitory effect (based on its concentration) in its motor and neurologic systems without the alteration of its cardio-respiratory functions and the neurological functions of the organism.

A COMPARATIVE STUDY OF THE QUALITY OF OELWEIN AND RURAL OELWEIN DRINKING WATER

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This study compared the total coliform and nitrate results of samples taken from city and rural water supplies in Oelwein, Iowa.

The rural water systems are located in an area of 1,385.66 acres which under the terms of a proposal, was to be annexed; the city sites are located throughout the city.

Those who favored the annexation of surrounding rural areas contended that the city of Oelwein would be able to provide a higher quality of water than that which is available in the rural Oelwein area. The annexation failed, thus leaving that statement unproved.

The purpose of this study was to determine whether water from city wells would be superior (in terms of nitrate and coliform levels) to that already in use in the surrounding rural area.

The study was performed in the following manner:

Sixty samples were collected using standard water collection methods. Variables tested for included nitrate levels and total coliform count. Quality control procedures were used in the preparation and execution of the total coliform bacteria test. A Hach simplified chemical analysis kit was used in the testing for nitrates. Standards were used in both tests, and for periodic verification of results, samples were taken by the University Hygenic Laboratory, in Iowa City, Iowa, under the direction of R.C. Splinter Ph. D., and Nancy Hall, Supervisor of Environmental Microbiology at the Hygenic Laboratory.

After the analysis of the samples was made, I concluded that the quality of water the city could provide to rural residents would not be significantly better than their existing water supply.

COMPARATIVE PUPIL REFLEXES BETWEEN HUMAN'S AND FELINES

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Since it has been well established that felines see better in lesser light intensities than humans, this study is designed to determine if pupil areas differ between felines and humans at different light intensities. If so, future investigations may lead to the use of the feline eye to negate night blindness in humans.

The tapetum of the cat is reported to have influence on the ability to see at lesser light intensities.

Ten humans and ten felines (Felis domesticus)were used as subjects. Using a 35 mm. camera, photographs were taken from 0 lumens to 1000 lumens. The photographs, taken from the same distance from the subjects, were enlarged and the areas of the irises and pupils were determined and compared.

The data indicated that as light intensities are reduced, pupil area increases in both felines and humans. The feline pupils increase in size more at very low light intensities than human pupils. At higher light intensities human pupils have more area. This suggests that the tapetum may be anatomically protected by the reduced pupil size at high light intensities in felines.

IMMUNE RESPONSE IN MAN

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The human body acquires immunity through stimulation of an immune globulin produced by the lymphocytes in part. The administration of Hepatitis-B vaccine to two previously non-immune subjects, showed that the lymphocytes did respond to the vaccine in that the total number of lymphocytes and the character of the lymphocytes was changed following the administration fo the vaccine. Concurrent monitoring of the liver enzymes showed a small rise in the activity of the enzymes but no evidence of an active disease process.

LICKING THE SALT HABIT: A COMPARATIVE ANALYSIS BETWEEN SODIUM AND POTASSIUM

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Sodium, which plays a major role in maintaining blood volume and osmotic pressure relation between cells, has suddenly become one of the leading health concerns. Statistics have made quite clear the connection between salt and hypertension along with kidney and other heart diseases. The purpose for this study was to prove the damaging effects of excess sodium consumption while proving the total effectiveness of potassium as a salt alternative. Three groups of experimental animals (Mus musculus) were formed. The first group was given sodium at levels consumed daily by average American individuals while being compared with the second group given the same level in potassium as a salt alternative. The third group was designated as the control and therefore received a normal diet. It was found that the sodium destroyed a large portion of the kidney tissue in fifty percent of the group receiving controlled excess levels of sodium. While this resulted in heart failure, the same level of potassium produced no ill effects. In conclusion, it was determined from this comparative analysis that the use of potassium as a salt alternative will reduce the risk of heart and/or kidney disease.

#A STUDY OF PLACENTAL HEXOKINASE

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Low cost, commercially available fructose has gained widespread use in food and drink. However, concern has developed about its safe use in human diets. A fructose-metabolizing enzyme, hexokinase, is present in human blood but absent from human liver and brain and the placentas of several animals. Possibly, hexokinase is absent from the human placenta. Fructose is the source of over 14% of the caloric intake of human mothers in the U.S. Therefore, an understanding of the metabolism of this sugar could be important to the health of the human fetus. In the present study the human placenta was examined using electrophoresis, chromatographic, and spectrophotometric methods. The results show that an active hexokinase is present in the mitochondrial fraction. HYPOTHESIS: If a ketohexokinase (fructokinase) is present in the human placenta, there could be an adverse effect on the fetus since this enzyme produces fructose-1-phosphate. However, the absence of fructokinase in similar tissues makesthe presence of a placental fructokinase unlikely. If a hexokinase is present which changes fructose to fructose-1-phosphate, then a toxic effect could occur and pregnant mothers must be advised of the possible complications of a high fructose diet. Future studies will address this hypothesis and determine the pathway of fructose transport in the human placenta.

#Fourth Award - General Motors ISEF

# ISOLATION OF THE Y CHROMOSOME SPERM FOR SEX DETERMINATION

Towarnicky, Mary Beth, Fessenden H.S., Fessenden, ND 58438
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The object of my project is to show a method that feasible and practical to predetermine by a significant percentage the male offspring. This can be applied in both family planning and in animal breeding such as raising beef cattle. A male offspring may be desired by career mothers or by those marrying late, by parents with all daughters, surrogate pregnancies and families with transmittable genetic problems.

Rabbits were used because of short gestation time and ease of collecting and inseminating semen. To induce ovulation in control and study females vasectomized bucks were used. An artificial vagina was constructed from two reinforced rubber casings 3.5 cm and 2.5 cm long with an inner diameter of 2.5 and 1.8 cm lined with a penrose rubber tube. Twenty-six control and 26 study females were used while sperm from 5 bucks were used. Sperm and motility counts were done prior to each insemination. Two volumes of .25 ml of semen was suspended in .25 ml of Tyrode solution. One was inseminated into a control rabbit. The other was layered over columns of 7.5% rabbit serum albumin for 1 hour, then removed. The rSA was centrifuged, then poured off leaving a sperm disk which was resuspended in Tyrode solution. This process was repeated using 12.5% rSA and 20% rSA. The final sperm disc in suspension was inseminated into study female rabbits.

Isolation of the Y chromosome sperm resulted in a 76.5% male offspring; 90.2% progressively motile sperm and no reduction in the total number of offspring (128) compared to the control (116).

#Second Award - General Motors ISEF

#NAEGLERIA FOWLERI: INHIBITION THROUGH ANTIAMOEBIC ANTIBODIES AND 'IN VIVO' SUSCEPTIBILITY TO FOUR ANTIPROTOZOAL AGENTS

Eward, Kathryn Leigh, Melbourne H.S., Indialantic, FL 32903
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This project was designed to lay the foundation for developing a successful treatment for primary amebic meningoencephalitis (PAME). This project entails three major areas of study and experimentation over a three year period. Initial phases (Pelomyxa carolinensis) included an extensive literary search and minimal inhibitory concentration (MIC) tests utilizing four antiprotozoal agents: Amphotericin B, miconazole, rifampin and tetracycline. Tests were designed to determine the agent with optimum inhibition efficacy. The second area of this project (*N. fowleri* 'in vitro') includes isolation attempts of Naegleria from fresh water, repetition of MIC tests, and MIC tests with Class III pathogen/causal amoeba *N. fowleri*. A spectrophotometry technique to measure agent effectiveness was developed. The third area (*N. fowleri* 'in vivo') includes repeated isolation attempts, development of optimum 'in vivo' inoculation techniques, development of scanning, electron micrograph procedures, and intranasal inoculation/therapeutic treatment. Success in removal of contamination from Naegleri cultures led to immunological studies. Amphotericin B has indicated optimum absorption in all 'in vitro' testing. Mice were susceptible to PAME only through intranasal inoculation. It is indicative that mice infected with certain samples and/or concentrations of Naegleria have produced antiamoebic antibodies. Immunodiffusion tests have been completed to determine antibody production levels. An attenuated strain from the virulent Naegleria has been produced. Direction for continuing research has been established and is currently underway.

#First Award - General Motors ISEF
Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society

THE EFFECTS OF TEMPERATURE ON ASTHMA

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This project involves an individual case study over a twelve month period, of a severe asthmatic, five years of age. It appeared his asthma was not caused by an allergy, but by the change in weather conditions. There are many variables involved with weather; humidity, temperatures, barometric reading. This study deals with the effects of temperature on asthma. The hypothesis stated that extreme hot and cold temperatures directly affected the length and severity of the asthma attacks. Atmospheric data was obtained from Columbia, Missouri National Weather Service. Asthma conditions were obtained from a dialy medical diary kept over the twelve month period. The relation between daily temperature variations and the effects the severity of the asthma attack were studied. Results were graphed--temperature highs and lows on y-axis with severity of attack on x-axis. Data from this study indicated that it was the sudden change in temperature which affected the attacks. In conclusion, it is evident that atmospheric conditions, specifically temperature variation, have a direct effect in severity and length of asthma attacks.

GENETIC ANALYSIS OF THE CANCER PHENOTYPE

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Human tumor and transformed cells are capable of growing as 3-dimensional multicell spheroids (MCSp). These MCSp exhibit properties of growth and viability which more closely resemble in vivo tumors than do monolayer or suspension cultures and give promise as models to increase our understanding of tumor biology. Normal human skin-fibroblasts, however, do not exhibit this phenomenon. In the present study a variety of somatic cell genetic techniques, including cell fusion and cell enucleation, were used to determine whether the MCSp phenotype is dominant or recessive and to attempt to define the role of the nucleus and cytoplasm in controlling its expression in crosses involving normal and cancer human cells. Two types of fusion products were isolated, hybrids and cybrids (cytoplasmic hybrids). These hybrids and cybrids were tested for expression of the MCSp phenotype.

The results show that: 1) Hybrids derived from transformed (WI38-SV40) and normal (75-80) crosses were capable of forming MCSp, but not all MCSp were capable of growth. This suggests that perhaps the MCSp phenotype is the result of a two-step process, cell aggregation and growth. 2) Hybrids resulting from tumor (HeLa) and normal (75-69) crosses expressed the MCSp phenotype with one exception. 3) All cybrids (cancer cell cytoplasm x whole normal cell), however, expressed the MCSp phenotype, suggesting that the cytoplasm plays a role in the expression of the phenomenon. 4) Differences in the growth behavior of MCSp derived from hybrid and cybrid cells as compared to MCSp derived from cancer parent cells were noted.

*First Award - American Veterinary Medical Association
First Award - General Motors ISEF
First Award - Tissue Culture Association
Merit Award - American Medical Association

THE USE OF TABACO MARINO (TOURNEFORTIA GNAPHALOIDES) AS A POSSIBLE INHIBITOR AGENT IN THE CHANGES OF HUMAN METABOLISM CAUSED BY THE RECURRENCE OF AN ASTHMATIC CONDITIONS

Castro, Jacqueline, CROEM High School, Mayaguez, P. R. 00709;

The purpose of this research is to identify the possible effect produced by chemical substances from inside the structure of a special plant, "Nigua de Playa" generally known as Tabaco Marino (Tournefortia gnaphalaoides) which improves the condition of an asthmatic attack in an individual.

The following experiment verifies this hypothesis:

Extractions from the juices of all parts of the plant were made and special attention was paid to which of them could be found to have a greater concentration of such substances. Teas were given to asthmatic patients and a comparative study of their effects on the patients was made.

From this investigation it is implied that the plant Tabaco Marino (Tournefortia gnaphaloides) decreases the symptoms associated with an asthmatic condition decreasing also the frequency of asthmatic attacks. The investigator thus infers that the plant of Tabaco Marino minimizes the quantity and frequency of said symptoms.

STARCH BLOCKERS FRIEND OR FOE

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Starch Blockers is a amylase inhibitor it blocks the starch from being broke down into maltose. In this theory the starch goes through the system without any food value and we would lose weight. To prove or disprove this theory, I plan to use 4 mice I am going to feed them each 10 grams of food and 15 mls. of water, the food contained 35% starch. My first mouse A would be fed no starch blocker he is my controlled subject. Mouse B,C, and D will be fed different amounts of starch blocker and there weight will be checked daily and then the data will be put on a graph to show any differences in weight. To check also if there is any strange effects caused by starch blockers.

#THE EFFECT OF AUDITORY STRESS ON THE CHEMOTACTIC REACTION OF POLYMORPHONUCLEAR LEUKOCYTES IN *MACACA FASCICULARIS* IN VITRO

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Noise has become a growing problem in today's society. However, of all forms of pollution, it has received the smallest amount of attention. It is a known fact that air pollution can kill, and water pollution causes disease, but noise acts so insidiously, that its effects are hard to ascertain.

The purpose of this project is to test the hypothesis that stress in the form of noise causes inhibition of leukocyte chemotaxis.

This research project, done in vitro, involved the acquisition of surplus blood samples from Macque monkeys that were part of other noise research projects at the University of Miami Medical School.

Chemotaxis was measured before, and again immediately following initial exposure to noise, and then at approximately two week intervals during exposure to the noise. Chemotaxis was also measured from blood samples of animals after prolonged exposure to noise. The test results from the blood samples were compiled, analyzed, and plotted on graphs.

The results of this experimentation decisively supported the hypothesis in this paper. As a result of these findings, the conclusion must be drawn that stress, in the form of noise, impaired the chemotactic reaction of polymorphonuclear leukocytes in *Macaca fascicularis*, thereby inhibiting the normal function of the immune system, and possibly increasing the host's susceptibility to disease.

#First Award - American Veterinary Medical Association
First Award - General Motors ISEF
First Award - United States Air Force
Honorable Mention - National Aeronautics and Space Administration

#A NEW NATURAL SUBSTITUTE FOR THE CHEMICAL MEAT PRESERVATIVE SODIUM NITRATE ($NaNO_3$)

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The compounds of garlic, papaya and tomato extracts were separated by their polarity properties, with the objective of isolating the compounds with the preservative action. Petroleum ether, methanol, ethyl acetate and water were the solvents used in the isolation of the compounds. Sterile pieces of meat were cut and injected with a dose of the preservative, equivalent to 30% of their weight (10.0 gr.). By each sample there was a piece of meat for every hour that a turbidimetry determination were done. The ethyl acetate layer of garlic had the largest preserving time up to 68 hours, with no effect over the meat color. The papaya aqueous layer had an average preserving time of 62 hours. Tlc plates with silica gel, were used to quantify the unknown compounds at the two fractions. The effects of different concentrations of garlic and papaya fraction on the growth of and toxin production by, Staphylococcus aureus was studied. Through all the research, we had developed a worry about the regulation of FDA over Sodium Nitrate on commercially processed meat products. The determination of $NaNO_3$ were done with sixteen different brands in 26 samples, that included: bacon, hot dogs, pork sausage, potted meat, sliced ham and turkey, bologna and salami. 63% of the generic products were over the 220 ppm regulated amount of Sodium Nitrate.

#Third Award - General Motors ISEF
Meritorius Award - United States Army

THE EFFECT OF SUBSTANCES OF DIFFERENT pH ON TOOTH ENAMEL

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The purpose of my research was to determine the effect of substances of different pH on tooth enamel. Nine human teeth were obtained. Each tooth was examined. Type and condition and weight were noted. Impressions were made. Each tooth was photographed. Each tooth was kept in a substance, within a pH range of 2 to 7, for seven days. The teeth were weighed and examined periodically. The final day of the experiment the teeth were examined, weighed and photographed. A second impression was made.

The teeth exposed to lemon and dilute concentrated HCl (both pH3) developed white, chalky areas, hypocalcification. The tooth in the freshly opened Coca-Cola (pH2) was most drastically texturally and visually changed. It became very brown, dry and chalky. It began to decay. The teeth exposed to a pH of 4 (orange and soda water) suffered hypocalcification to a lesser degree than the teeth exposed to a lower pH. The substances of highest pH were aspirin (pH5), candy (pH6) and milk (pH6.2). They caused the least hypocalcification. The tooth exposed to distilled water (pH7-neutral) was the control. It did not change.

I have concluded that within a pH range of 2 to 7, substances of lower pH cause more damage to tooth enamel than do substances of higher pH.

Thus, excessive consumption of foods and beverages of low pH should be avoided in an effort to maintain healthy teeth.

#EFFECTS OF DIAGNOSTIC ULTRASOUND ON CHICK EMBRYOS

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The use of ultrasound as a diagnostic tool has become increasingly popular over the last several years. Often, pregnant women receive applications of ultrasound repeatedly during pregnancy. An increasing number of animal studies have suggested links between diagnostic ultrasound and certain abnormalities, especially of the central nervous system, but most of the physicians who utilize this tool claim that it is entirely safe, and thus, women often receive these tests totally ignorant of the possible risks.

The purpose of these investigations was to observe the effect of 15 minute diagnostic ultrasound applications on 13-day old chick embryos. Dosage level was within the range of that used for pregnant women, and an equal number of control chick embryos was used.

Because of the low incidence of deleterious effects in other studies involving animals exposed to ultrasound, no ill effects were expected in this study. In the first experiment, one ultrasound-exposed chick hatched with a disfigured neck, while the controls that hatched were normal. Due to the difficulties in the first experiment and the resulting low experimental numbers, a second experiment was conducted in which the ultrasound chicks experienced an increased pre-hatch and post-hatch mortality over the control chicks. In addition, two ultrasound chicks exhibited abnormalities (a lesion on the skull and brain of one, and a total eviseration of another), while the control chicks experienced no such ill effects. These findings could be significant because the same mechanisms causing the defects in the chicks could possibly cause adverse effects in human fetuses.

#Honorable Mention - Acoustical Society of America

#HEMODYNAMIC DIFFERENCES IN SHR AND WKY RATS

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The purpose of this investigation was to contract the difference in the biophysical properties of the in vivo arterial system in hypertensive and normotensive rats. Studies were performed on 7 hypertensive (SHR) and 6 normotensive (WKY) to test the hypothesis that SHR rats have a lower arterial compliance (C) than WKY rats. All rats were anesthetized with 10% urethane intraperitoneally and underwent a midline thoracotomy with placement of an electromagnetic flow probe and a catherter-tip monometer in the aorta. Steady-state pressure (Pm) and flow (Fm) were used to calculate total peripheral resistance (Rp). Prolonged diastoles were produced by an EKG timed aortic occluder. The decay time constant (T) for each prolonged diastole was calculated by an exponential fit of the initial linear segment of the log (pressure). Arterial compliance was calculated from the relationship C=T/Rp. The results (mean ± SD) are summarized in the following table:

	Pm (mmHg)	Fm (ml/sec)	T (sec)	Rp $\frac{\text{(mmHg*ml/sec)}}{\text{(sec)}}$	C x 10^{-3} (ml/mmHg)
SHR	104	.477	.180	227	.878
	± 16	±.082	±.050	±62	±.335
WKY	82	.414	.216	205	1.10
	± 16	±.114	±.072	±47	±.314

Thus, the defect appears to be throughout the arterial system of the SHR and not just at the arteriolar level as suggested by abnormal Rp.

#Third Award - General Motors ISEF

MALE VS. FEMALE: SEXUAL DIMORPHISM OF MUSKRAT (ONDATRA ZIBETHICA) BRAIN

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Frozen sections of adult female and male muskrat brains were compared for sexual dimorphic differentiation. Sexual differentiation has been found in the brains of rats, mice, hamsters, canaries, zebra finches, and humans. The purpose of this study was 1.) to investigate sexual dimorphism in a species' brain that has not previously been studied 2.) to learn the techniques necessary to make histological sections. The muskrat heads were obtained from the biomedical department at the University of Idaho, the skulls removed, and the brains preserved in Telly's fixative followed by a graded series of sucrose solutions. Sections were made on a sliding microtome (using dry ice and ethanol) and stained in cresyl-violet. Tracings of the sections were made from microscope projections. The paraventricular, preoptic, and suprachiasmatic nuclei and the corpus callosum were measured with a polar planimeter. The suprachiasmatic and preoptic nuclei were larger in the male and the paraventricular nucleus was larger in the female. The corpus callosum (the connecting fibers between the brain halves) was almost 3 times larger in the female. The literature reports the suprachiasmatic and preoptic nuclei are larger in the male of all species studied. This muskrat study agrees. Since the paraventricular nucleus is responsible for oxytocin secretion (active in females for uterine contraction and lactation), it seems reasonable that this nucleus would be larger in females as this study found. The large corpus callosum in the female parallels the findings in humans. Sexual differentiation found in the brain provides important evidence that behavioral and physiological differences in the sexes are affected by a significantly different biology in the male and female.

#THE ROLE OF A PRIMARY ALCOHOL, (TRIA) IN THE CELLS GROWTH AND DEVELOPMENT OF P-388 LYMPHOCYTIC LEUKEMIA IN DBA-2J MICE AND EAT TUMOR IN SWISS WEBSTERS.

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My purpose is to determine the inhibitory activity of Triacontanol CH_3 $(CH_2)_{28}$ CH_2OH in the growth and development of animal cells in DRA-2J and Swiss Swebsters mice infected with P-388 Lymphocytic Leukemia and EAT tumor, respectively. I injected Triacontanol solution (1mg/L) intraperitoneally;DBA-2J mice infected with P-388 Lymphocytic Leukemia, 0.1 cc and 0.3 ccduring ten days, and Swiss Websters infected with EAT tumor with same quantity as above, but during twenty days.

Afterward I performed Leukocyte Blood Smear Test, Lymphocyte Cell Counting and a Histological Study to be compared with the Weight Analysis Data.

I found that the Triacontanol solution did not inhibit the P-388 Lymphocytic Leukemia neither the EAT tumor, in the mice as it was reported in the article of C.D. Hufford and B.O.Oguntein, NON POLAR CONSTITUENTS OF JATHROPA CURCAS. The article confirmed inhibitory activity in vivo and in vitro on P-388 Lymphocytic Leukemia in BDF_1 mice.

In my investigation, I show that the Triacontanol, known as a NON-POLAR COMPOUND; stimulates the growth of normal and infected cells, proved by the results obtained in the comparison of weight in the normal mice and those infected with tumors and these were verified through Cellular Analysis.

#Fourth Award - General Motors ISEF

THRUSH-EQUINE MONILIASIS-A COMPARATIVE TREATMENT

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Thrush, a fungus that affects the equine hoof, has long been the enemy of the breeder and showman. While rarely causing death, it can cause lameness and unhealthy condition of hooves. The common treatment of thrush, that of 7% tinchture of Iodine, stains both handler and equipment, thus detracting from competition.

The purpose of this experiment is to establish a comparable treatment for equine moniliasis--commonly known as thrush - other than that of 7% tincture of Iodine. Using the growth and isolation process, the disease causing fungus was discovered to be Candida albicans. Based upon blood agar cultures using Iodine and 5.25% sodium hypochlorite in the form of Clorox*, the 5.25% sodium hypochlorite equaled 7% tincture of Iodine in effectiveness. Saboraud plates were then prepared using 2 fold solutions graduated to 100,000 fold isotonic solutions of the disease causing fungus. The effectiveness of 5.25% sodium hypochlorite appeared to surpass that of 7% tincture of Iodine. Clinical trials were performed using six equine subjects infected with thrush. Front hooves were treated as one trial and back hooves as another. Seven percent tincture of Iodine was used to treat one half of each trial while 5.25% sodium hypochlorite was used to treat the other. Results appear to show superior effectiveness of 5.25% sodium hypochlorite.

This investigation leads to the possibility that various dilutions of sodium hypochlorite in the form of Clorox* might be used to treat skin fungus, fungus growths under cast and other related fungi on equine subjects.

#GROWTH AND DIFFERENTIATION OF BONE MARROW CELLS INTO SPECIFIC TYPES OF WHITE BLOOD CELLS

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Cells from the marrow of long bones give rise to 2 million white blood cells of different types every minute. This project was undertaken to determine what conditions were needed for bone marrow cells to proliferate and to differentiate. It was found that bone marrow cells did not proliferate in tissue culture medium even if fresh medium containing nutrients was added every 2 days. But when the medium in which certain other different types of cells had been growing was added, the bone marrow cells proliferated. The bone marrow cells that proliferated in the presence of medium in which one type of tumor cell had been growing, were basophils, a type of white blood cell important in allergy. The type of cell that proliferated in a medium in which another type of tumor cell had been growing, was a macrophage, a type of white blood cell important for protection against germs and important in immunity. Medium in which certain normal cells had been growing could make bone marrow cells proliferate, but only some of the media made them differentiate into basophils and macrophages. Therefore, the growth and differentiation of bone marrow cells may need the products of other cell types and these products can be found in the medium in which the other cells grow.

#Fourth Award - General Motors ISEF

ALLOMETRIC, VOLUMETRIC ANALYSIS; REGENERATIVE MITOTIC MODIFICATION OF NEOBLAST TISSUE USING STIMULANTS, HORMONES, VITAMINS, ELECTRICAL STIMULATION, X-IRRADIATION, *ASTERIAS SP.* EXTRACT FRACTIONS IN *DUGESIA TIGRINA*.

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Histological development of regenerating *Dugesia tigrina* cells was evaluated using vitamins, stimulants, hormones in varying molar concentrations, electrical stimulation and x-irradiation. Neoblasts with intercellular extensions preceeds cellular differentiation. Colchicine and acetocarmine chromosome staining showed variations in mitotic rate. Chromatographic analysis of DNA from each regenerative culture indicated differences in the amounts and types of amino acids.

Length and width measurements of head and tail bisections in millimeters were taken of each planarian immediately following bisection and at intervals until regeneration was complete. The planaria were induced to stretch maximally for longitudinal and transverse measurements. Allometric and volumetric growth was evaluated using the respective formulas, $A = \frac{L \times W}{2}$ and $V = \frac{L \times W^2}{2}$.

Electrical stimulation above 2mA for any time interval caused an increase in regeneration time. Irradiation caused a high loss of initial regenerative ability followed by a rapid regenerative recuperation at doses of 25-75 rad. Extraction of a regenerative substance from *Asterias sp.* showed a 200-fold decrease in regeneration time, not exclusively interspecific. Column and two dimensional chromatography show the regenerative substance to be a low molecular weight (approximately 300 Daltons) protein.

#TOXIC SHOCK SYNDROME PHASE II: DETERMINATION OF ANTIBODY PRODUCTION AGAINST CAUSATIVE ORGANISM

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Toxic shock syndrome is a rare but potentially lethal disease that occurs at the rate of 15 per 100,000 persons per year. Immunization against TSS could possibly eradicate this disorder. The purpose of this research was to determine if antibodies are produced against *Staph. aureus* Exotoxin C "+" D1233, the causative organism. Also, does serum containing antibodies inhibit the symptoms of TSS?

The bacterial cultures were plated on CTM plates to determine purity. The toxins were purified through centrifugation, filtration, and ethanol precipitation. The lowry protein assay was used to determine the total protein. Rabbits were given iv injections of the toxins and temperature responses were recorded over a 4-hr. period rectally to determine pyrogenicity. Rabbits were pre-bled to obtain serums which were subjected to double gel diffusion to establish that the animals had not previously developed antibodies to *Staph. aureus*. Rabbits were injected with the toxins plus complete Freund's adjuvant. After two weeks the rabbits were reinjected with the toxins plus incomplete Freund's adjuvant. After another two week period, the rabbits were bled, and the serums were used for the detection of antibodies using double gel diffusion. A third rabbit was injected with the serum containing antibodies against the Exotoxin C "+" D1233. It then underwent a pyrogen test to determine if the antibodies would suppress the rise in temperature. Responses were recorded over a 4-hr. period. Results from all trials were recorded and analyzed.

Based on the data obtained, the researcher concludes the following: 1) Antibodies are produced against *Staph. aureus* Exotoxin C "+" D1233; and 2) Serum containing antibodies does suppress the symptoms (fever) of toxic shock syndrome.

#Third Award - General Motors ISEF

THE EFFECTS OF INORGANIC MERCURY ON LABORATORY MICE

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This was an experiment to observe and record the amount of memory deterioration in laboratory mice after having been exposed to inorganic mercury through their food source. By ratioing the amount of mercury to food each mouse received approximately .25 grams of mercury.

Each mouse was run through a maze daily, before and after exposure to inorganic mercury. Before exposure each mouse's maze run was timed and averaged; then compared to timings taken after exposure.

Upon completion of this experiment each mouse's time had increased substantially, but through observation time increase seemed due to lack of enthusiasm rather than memory loss, although at times they appeared confused.

Autopsies were conducted. Findings of the autopsies showed that the large and the small intestines were bloated to four times their normal size. The liver and the heart were discolored to a dark red instead of their normal pinkish color and both were enlarged significantly. The spleen and the pancreas were also discolored; close to hemorrhage. The fat inside the skin was yellow and fleshy, signs of jaundice. Signs of pneumonia and mucus in the lungs were found in the mice.

EFFECTS OF CORTISONE ON BONE DEVELOPMENT IN XENOPUS LAEVIS

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Studies in chickens, rats, rabbits, and mice have shown that cortisone retards or completely prevents the ossification of various endochondral and membranous bones. In this study, actively feeding *Xenopus laevis* tadpoles were treated with cortisone acetate in concentrations of .2mg/l and .4mg/l. The development of ossification sites and bone growth were observed over a period of seven weeks. Results indicate that in *Xenopus laevis*, cortisone slightly inhibits bone growth. No measurable effect on ossification has been found.

PREGNANCY TESTING IN CATTLE

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The purpose of this project is to explore new possibilities in pregnancy testing in cattle. Currently, pregnancy tests are taken by veterinarians. For this project, four tests were developed: 1) Charcoal Test; 2) EPT Test; 3) Dip Stick Test, and 4) Crystallization Test. The charcoal test consisted of pouring a urine sample over a small amount of charcoal and allowing it to crystallize. EPT tests are available in drug stores for inhome early pregnancy tests and Dip Sticks are used for clinical urine tests. The crystallization test was conducted by preparing a glass slide with the urine sample and allowing it to crystallize. The charcoal, EPT, and Dip Stick tests did not distinguish between pregnant and non-pregnant urine samples. The crystallization test, however, showed distinct differences in the formation of pregnant and non-pregnant urine sample crystals.

#THE EFFECTS OF DMSO ON MURINE SARCOMA CELLS

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In this experiment, dimethyl sulfoxide (DMSO) was applied to the nutrient media of colonies of murine fibrosarcoma cells under controlled conditions. These are malignant, fibro-connective tissue cells from a mouse. After review of current medical literature, it was hypothesized that there would be some form of cellular differentiation due to the application of dimethyl sulfoxide, either the inhibition or stimulation of cell growth.

Colonies of cells were cultured. DMSO was added in concentrations of .5, 1, and 1.5 percent in equal volumes. Controls were running parallel. The cells were studied and counted every three days. When culturing the cells, the sterile technique was used.

Results from over seventy flasks show that dimethyl sulfoxide significantly increases the rate of cell replication. Based on these results, three possible applications can be considered: first, dimethyl sulfoxide could be used as a supplement in the culturing of tissues because it increases replication. Secondly, since the substance produces an increase in cell replication, it is theoretically possible that in certain types of slow growing tumors, chemotherapy, which attacks the dividing cell, might be made more effective by the addition of DMSO. Thirdly, some tumors with rapidly dividing cells can grow so quickly that they outgrow their blood supply. The researcher feels that DMSO might in some cases cause a tumor to outgrow its blood supply and die.

#Second Award - Tissue Culture Association
Fourth Award - General Motors ISEF

BACTERIAL MUTATIONS AND THEIR RESPONSE TO ANTIBIOTICS

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PURPOSE: To produce mutations of Pseudomonas and Escherichia coli with ultra-violet light and test their response to three common antibiotics.

PROCEDURE: Pseudomonas was grown on Mueller-Hinton agar and Escherichia coli on EMB agar, for ease in identification. The bacteria were then exposed to ultra-violet light for intervals of 5, 10 and 15 seconds. Discs impregnated with Carbenicillin, Colistin and Streptomycin were used for sensitivity testing. Responses were recorded and compared with standardized results, and any colonies found within the antibiotic zones were noted and counted. In order to determine if the bacterial colonies growing within the zones surrounding the antibiotic discs were true mutations, sub-cultures had to be made of these colonies and their sensitivity re-tested. These responses were then recorded and compared with standardized results and parent plate results.

CONCLUSION: It is possible to produce mutations of bacteria with exposure to ultra-violet light. Character and color changes are visible to the naked eye even after short periods of exposure.

ANALYSIS: Responses to antibiotics are altered in the mutated state in some cases, depending on the antibiotic and bacteria tested. All the mutated Pseudomonas were resistant to Carbenicillin and Streptomycin, but still sensitive to Colistin. Mutations of Escherichia coli were resistant only to Carbenicillin, but still sensitive to Colistin and Streptomycin.

THE EFFECTS OF CHEMICALS ON CHICKEN EMBRYOS

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Purpose: To discover the effects of common chemicals on chicken embryos in relation to human embryos.

Procedure: Place eggs in a regulated incubator and turn eggs once a day. On the 4th day inject 6 eggs with each predetermined amount of that chemical. On the 10th and 17th day, break open 2 eggs in each group, including 2 control eggs for comparison. Observe and record data. Chicks should hatch on the 21st day, data should be taken.

Data: A 28g insulin needle was used to inject eggs , chemicals used were: alcohol(.1 and .05cc), coffee(.1 and .05cc),acetaminophen (.1 and .05cc), nicotinic acid(.1 and .05cc), 7/10 saline solution (.1cc), and aspirin(.1,.15,and .05cc). The development of coffee and aspirin injected eggs was stopped almost immediately after injection and the other chemicals caused slower development and a higher incidence of mortality and deformities.

Conclusion: Based on the research presented, it could be concluded that certain common chemicals that are consumed daily by the average American may cause developmental problems and even death in chicken embryos. Therefore, comparable ratios of these chemicals consumed by pregnant women could result in internal or external deformities of the human fetus.

#RELATIONSHIP OF NZB AUTOANTIBODY GENES IN NZB x C58 RECOMBINANT INBRED MICE

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Recombinant inbred (RI) strains allow a new approach to the study of autoimmunity in the New Zealand black (NZB) mouse, a model for human autoimmune disease. In the present study, roughly 300 mice at least two months old representing the two progenitor strains (NZB and the non-autoimmune C58) and the eleven NZB x C58 RI strains were bled and screened for the presence of several autoantibodies initially and at several 2-4 month intervals by means of ELISA techniques, some developed by the researcher. The most important findings thus far are: two regulatory gene defects control autoantibody production against double-stranded DNA; the major gene involved in anti-single-stranded DNA autoantibody production is linked to a xenotropic murine leukemia viral (MLV) insertion (unrelated to the overall viral phenotype) near the Hbb locus on chromosome 7; a similar viral fragment-linked gene causes the production of anti-tRNA autoantibodies; and most important, the Ir locus of the H-2 complex on chromosome 17 is strongly implicated as the site for a single gene that determines the incidence of anti-thymocyte autoantibodies and is one of two genes promoting anti-B cell autoantibodies (the other being most likely a regulatory gene). No antibody heavy or light chain structural genes are implicated thus far. Collectively, the results suggest a new model of NZB autoimmunity in which the autoimmune phenotype is initiated and maintained by independently segregating regulatory gene defects that combine in varying degrees with xenotropic MLV insertions into the genome and with at least one Ir locus defect of the H-2 complex.

#Second Award - General Motors ISEF
Second Award - United States Navy
Honorable Mention - United States Air Force

ROLE OF THE PINEAL GLAND IN THE GROWTH AND HEALTH OF RATTUS

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The pineal gland, and the hormone serotonin, was studied to determine its role in growth and health of rattus. In the first experiment, Rat A was exposed to 168 hrs. in a normal circadian cycle; 168 hrs. in constant light; and 168 hrs. in a normal circadian cycle. Rat B was exposed to 168 hrs. in a normal circadian cycle; 168 hrs. in constant darkness; and 168 hrs. in a normal circadian cycle. Weight and behavior were recorded. In the second experiment, Rat A was exposed to 240 hrs. of constant darkness; Rat B to 240 hrs. of constant light. In the control group, Rat C was exposed to 240 hrs. in a normal circadian cycle; Rat D to 120 hrs. in a normal circadian cycle. Weight and behavior were recorded. Next, brain solutions were prepared for each rat by extracting brain tissue and combining with 10 ml of $HCLO_4$/gram of brain weight. Solution was injected into a liquid chromotography machine; serotonin levels for each rat's brain tissue were recorded. Low levels of serotonin occurred in the rat exposed to constant darkness and appeared to be a factor in hyperactivity, weight gains, decreased sleep, and increased locomotor activity. High levels of serotonin occurred in the rat exposed to constant light and appeared to be a factor in inactivity, weight losses, increased sleep, and decreased locomotor activity. Normal levels of serotonin occurred in the control rats, and their growth rate, habits, and activity levels were normal for the rattus species. In conclusion, the varying levels of serotonin played an important part in the growth rate and behavioral patterns of rattus.

THE EFFECTS OF METKEPHAMID, A NATURAL ANALGESIC ON SHEEP

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Each year, numerous lambs and calves are suffocated to death during labor resulting from their mothers's inability to relax. To prevent these tragedies from happening, we must find a relaxant or an analgesic that can be safely administered on pregnant animals.

Metkephamid is an analgesic and an analog of a peptide, met-enkephalin, that is naturally excreted by the brain. Research has proven that metkephamid will act as an analgesic and have minimal after-effects on mice. The objective of this research is to test metkephamid's analgesic ability and to find out all the after-effects of the drug on lambs and ovine fetus. The result of this research would have direct relevance to the effect of metkephamid in human.

To reach this objective, a catheter is first surgically implanted in the fetus inside of the pregnant ewe and in the lamb after the birth; there is also a catheter in the ewe to monitor the effect of the drug on the ewe. During the experiment a combination of metkephamid and naloxone(narcotic antagonist) or one of the two drugs is infused through the catheter into the vein. Heart rate and respiratory rate will then be recorded on electrical cardiograph (EKG); blood samples were also taken through the catheter every 15 minutes in the hour after the infusion. The EKG and the blood samples were then analyzed for the effect of the drug on the fetus and lamb.

The results of the experiments have shown promises in metkephamid's future, but further research is needed to confirmed the findings.

EFFECT OF PARTIAL PANCREATIC INSUFFICIENCY (PPI) ON FOOD INTAKE IN THE RAT

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Appetite may be regulated by satiety factors released from the small intestine by contact with food. One putative satiety factor is cholecystokinin (CCK), a hormone released from the proximal small intestine and which stimulates the pancreas. Conditions which would cause greater release of gut CCK may reduce food intake because exogenous CCK reduces food intake in the rat. Our previous studies showed that partial exclusion of pancreatic juice from the intestine (PPI) caused greatly increased pancreatic secretion in response to dietary protein, and this is most likely caused by increased release of CCK. We therefore tested the hypothesis that PPI would decrease food intake in the rat. Rats were surgically prepared with cannulas to collect pancreatic juice, all of which was returned to their intestine except where experimental conditions dictated otherwise. They were trained to eat their daily food ration between 0900-1100 hrs and 1400-1600 hrs. Rats were assigned to two groups, one to receive a normal amount of pancreatic juice and the other to receive 5% of this amount (sufficient to prevent malabsorption), infused into the small intestine. Food (a powdered, semi-synthetic diet) was presented 0.5 hours after pancreatic juice infusion began and total food intake during the following 2 hours (0900-1100 hrs) was measured. Experiments were performed on the 4th and 5th post-operative days, using a cross-over design. RESULTS AND CONCLUSIONS: Food intake was significantly increased by 40.3% in rats with PPI. This finding is opposite to that predicted by our hypothesis. It is not due to a shortcoming in experiment design, since partial exclusion of pancreatic juice did cause, as expected, significantly greater stimulation of pancreatic secretion. We conclude that PPI increases short-term food intake in the rat. This may mean that increased release of CCK did not occur under PPI, or more likely, that the satiety effect of CCK was overridden by other events caused by reduced pancreatic juice in the intestine.

OCCUPATIONAL ASTHMA

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This study is concerned with the effects of corundum and perlite particulates on *Homo sapiens* lung fibroblast cells grown *in vitro*. Both of the experimental dusts are commercially available and used by some industries and hobbyists. The researcher chose to develop a model system in which the toxic effects of these particulates could be determined.

Serial dilutions of each particulate were prepared and applied to fibroblast tissue cultures of Human Embryonic Lung Cells (HEL). Observations were made at intervals of 1, 4 and 72 hours of incubation. Polaroid prints, 35 mm slides and Giemsa stained plates were prepared from experimental and control cultures. Analysis of the result showed that corundum particulate matter had no toxic effects on the cells even after 72 hours of incubation in all of the dilutions tested. Perlite dust showed minimal toxic effects on the cells at 1 and 4 hours of incubation; however, the cells were completely killed after 72 hours of incubation at the higher concentrations. Low concentrations also exhibited a high mortality rate.

A t-test, used to statistically analyze the data, verified the significance of the results. The researcher concludes that corundum does not have toxic effects on HEL cells grown *in vitro* with the concentrations tested, and that perlite is toxic at these concentrations.

#THE DEVELOPMENT OF AN IMPROVED TECHNIQUE FOR CULTERING PERIPHERAL BLOOD CELLS FROM CHINESE HAMSTERS FOR THE STUDY OF THIOACETAMIDE INTOXICATION ON CHROMOSOMES

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The purpose of this research was to develop a technique that would enable the investigator to culture peripheral blood cells from the Chinese hamster; future study will involve the effects of thioacetamide on the chromosomes of this animal.

Many occupational workers are exposed to cancer-causing agents everyday. Since one cannot inject a human with a possible carcinogen, live animal research has become increasingly important in trying to find the possible role of a carcinogen in a living system. However, most mammals, including humans, have far too many chromosomes for detailed chromosome work. Because of this abundance of chromosomes in cells in the metaphastic state, it is impossible to score chromosomes in most mammals. However, there is one species of hamsters, *Cricetus grisetus* (Chinese hamster), which has only twenty-two chromosomes. This small number of chromosomes makes the scoring of them much easier because there is not as much overlapping.

A procedure for the cultering of peripherial blood cells from Chinese hamsters has been suggested by DeJong, but he states that he has had limited success.

After duplicating DeJong's procedure several times and experiencing no success, the investigator began to modify this procedure. After ten months it has been found that a lower centrifuge speed, increased culture time, a bottle-shaped vial, higher amounts of PHA and 2-mercaptoethanol, and the use of Haemacel instead of Ficoll greatly increased the number of cells produced. Using DeJong's procedure with these modifications has made the observation of chromosomes possible.

#Fourth Award - General Motors ISEF

#*MOMORDICA CHARANTIA* AS A POSSIBLE ARACHNICIDE AGENT IN THE TREATMENT OF *PSOROPTES CUNICULI* AND *PSOROPTES SCABIEI* IN *ORYPTOLAGUS CUNICULUS*

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Medicine, recognizes curative properties in certain plants, such is the case of many autoctonous plants native of Puerto Rico. It is part of the Puertorican foklore to treat several maladies with extracts from plants native to the island.

A questionaire was made and it revealed that mange affects the breeding of rabbits. This investigation is based on the use of the extract from the plant *Momordica charantia* (Wild Balsam Apple) known in Puerto Rico as "cundeamor", as an effective treatment of rabbits infected with different types of mange.

A taxonomical and morphological study of the leaves was made. Identification of the arachnids: *Psoroptes cuniculi* and *Sarcoptes scabiei*, as the parasites causing mange, was verified with the aid of a veterinary. Morphological studies and anatomical differentiation of the arachnids were made.

Different concentrations of the extract were used in the treatment of rabbits, demonstrating that the concentration 20-25 was the most effective. The extracts were then analyzed for its chemical components. Thin layer chromatography (T.L.C.) analysis were made and the components were separated.

#First Award - American Veterinary Medical Association
First Award - Eastnam Kodak Company
Third Award - Entomological Society of America.

#DETECTION AND ROLE OF ANTI-LYPHOCYTE ANTIBODIES IN CANCER SERA

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The present study determined whether anti-lymphocyte antibodies against Natural Killer(NK)cells are in cancer sera and inhibit NK cytotoxicity. NK cells are non-B non-T lymphocytes that spontaneously lyse tumor cells and may be a tumor surveillance system. This NK cytotoxicity is impaired in some cancer patients. Some of this impairment is due to humoral factors in the sera(Bankhurst and Sibbett),1980. In Systemic lupus erythematosus, ALA's are NK suppressive factors and some cancer sera have immune complexes, so NK inhibiting ALA may also be in cancer sera. The hypothesis was that NK suppressive ALA are present in cancer sera. Procedure: 1)Nylon-wool non-adherent lymphocytes were separated into a non-T population using sheep red blood cell rosetting, 2)The non-T cells with Fc receptors blocked were incubated at 4C with suppressive serum, 3)The cells were washed and incubated with fluorescenated goat anti-human immunoglobins to detect ALA, and 4)The fluorescence was detected on Fluorescence Activated Cell Sorter(FACS). The results showed that three sera had NK specific ALA of the Mu, Gamma, and non-Mu non-Gamma classes. The sera with ALA were severely NK suppressive and the non-NK suppressive sera had no ALA, suggesting ALA involvement in NK suppression. The hypothesis was supported. Further studies will be designed to determine the mode NK suppression and ALA's specificity. Analyzation of ALA may provide clues to decreased tumor resistance in some persons and the effect of cancer on its host. This research may also help NK surface analyzation.

#Third Award - General Motors ISEF

#ANALYSIS OF THE HUMAN VOCAL SYSTEM IN VOWEL PRODUCTION

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The purpose of this project is to determine what makes one vowel sound different from another. The hypothesis is that the tongue is the primary modifier of vowel sounds.

For simplification, the human vocal system is divided into three general parts: the lungs, the larynx, and the vocal tract. A mechanical "speaking machine" is built to simulate these parts in vowel production. A controllable flow of air enters a rectangular box containing an artificial larynx. A directional flow of sound is produced and passed through clay models of the mouth.

Three parts can be controlled in the experiment: the laryngeal sound, the tongue positions, and the lip positions. While two of these factors are kept constant, the third is varied. After the artificial vowel production is refined, a comparison is made between synthesized and natural vowel sounds amplified into an oscilloscope.

Results prove that the tongue is the primary modifier of vowel sounds, and that the lips play a further role. The character of the sound leaving the larynx plays no role in vowel modification. The hump formed by the tongue divides the mouth into two volumes of air. This hump creates a dual resonance system, and is prevalent in most vowels. It was also found that the vowels made by the speaking machine and those of the natural vowels have vague similarities in waveforms on an oscilloscope.

#Third Award - General Motors ISEF

#DO BETA-BLOCKERS EFFECT THE CARDIOVASCULAR IMPROVEMENT OF CARDIAC PATIENTS INVOLVED IN AEROBIC EXERCISE PROGRAMS?

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This fourth year study of running and its effect on various physical systems, centers on the medicated patient in rehabilitative programs. Beta-blockers represent one of the fastest growing class of medications used to treat cardiac and hypertensive patients. These patients are being refered or enrolling in cardiac rehab and wellness center aerobic programs. Beta-blockers cause a significant reduction in the exercise induced heart rate. Most programs monitor heart rate to determine if the patient is exercising at an appropriate level to experience cardiovascular improvement. The question is, are these medicated patients receiving cardiovascular benefit from aerobic exercise at their reduced heart rate?

Patients were selected which had just enrolled in aerobic programs at two wellness centers. 10 were taking beta-blockers and 10 were not taking beta-blockers (control). Their programs were developed and their cardiovascular test data recorded for 3 months. Maximum oxygen consumption (VO_2 max) values were used to measure cardiovascular improvement. This test is not effected by beta-blocker medications. Results showed that regardless of beta-blocker (non-selective or cardio-selective), age (mean 49), or dosage ranges, these patients showed a mean increase in VO_2 max of 33.5%. Control group increase was 27.4%. The Chi-square test and distribution show the results were significant with only a percentage error of 0.02%.

Approved patients, taking beta-blockers, can experience significant cardiovascular improvement from aerobic programs. Their exercised induced heart rate reduction of 30% should not preclude their participation in these programs.

#Fourth Award - General Motors ISEF
Merit Award - American Medical Association

THE EFFECTS OF VARIOUS CULTURE MEDIA ON EMBRYOGENESIS IN _IN VITRO_ FERTILIZATION

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The purpose of this investigation is to determine the relative effects of certain culture media on embryogenesis in mouse ova fertilized _in vivo_. _Mus musculus_, embryologically comparable to the human, is used as the experimental animal. Prepuberal females are injected with 5 I.U. each of a follicle stimulating hormone and a luteinizing hormone to induce superovulation. 36 hours after the LH injection, approximately 30 eggs are taken from 6 females by flushing the oviducts with a modified Krebs solution (adjusted to 7.35 pH and 280 mOs/kg and filter sterilized). Ova, in groups of 7, are placed in vials containing various culture media. These substances include fetal cord sera, nonpregnant human sera, progesterone, and estradiol. The vials are placed in an incobator and observed for three days. Data are derived from the percent of morula/blastocyst development in each medium, and comparisons of relative success are then made. Quantitative results indicate that fetal cord sera in Hams is the most successful medium assayed here (92.3 % returns). Estradiol, when added to a Krebs medium, sustains almost 100% of ova development to the blastocyst stage. This study, then, suggests that estradiol may have applicability in human _in vitro_ procedures as a media additive. More importantly, though, this assay is the most reliable indicator of a culture medium's promise as a medium for use in human _in vitro_ fertilization procedures.

WHAT TYPE OF VITAMIN IS BEST FOR METABOLISM

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The purpose of this project was to decide which type of vitamin is best for the metabolism of yeast by comparing the carbon dioxide production. The experiments included synthetic vitamins, organic vitamins, and cold processed vitamins.

In the major experiments, each tube had two milliliters of 50% sucrose and 1 milliliter of a 1-in-10 diluted solution of 4 grams of yeast in 100 milliliters of acetate buffer. In separate tubes, ammonium sulfate, yeast extract, potassium phosphate, Geritol, a synthetic vitamin, and a cold processed vitamin were added. The combinations tested ammonium sulfate with yeast extract, ammonium sulfate with the synthetic vitamin, potassium phosphate with Geritol, potassium phosphate with the synthetic vitamin, and potassium phosphate with the cold processed vitamin. More complicated combinations compared the synthetic, cold processed, and organic vitamins with ammonium sulfate, potassium phosphate, and yeast extract added to each tube. The last tubes were done in the same manner with the exception that yeast extract was not included.

The first conclusion learned through this experiment was that using the correct suspended yeast dilution is vital. Secondly, vitamins by themselves, do not appear to affect the metabolism of yeast. Ammonium sulfate and potassium phosphate by themselves do not vary the metabolism, either. A combination of all the ingredients does vary the metabolic rate.

Finally, there is an increase in the rate of metabolism in yeast when cold processed vitamins are used instead of either synthetic or organic vitamins.

#THE EFFECT OF D-GLUCOSE ON THE CARDIOVASCULAR SYSTEM

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Stress is the nonspecific result of any demand upon the body. Prolonged stress can trigger biological imbalances such as abnormal response to sugar. Perhaps acute stress can be affected by the ingestion of large amounts of sugar. Stress is known to be an important factor in the development of heart disease. However, few studies have been conducted to show the effect of D-glucose on the cardiovascular system under stressful conditions. In today's society, individuals experience stress in their daily living. At the same time, popular dietary concepts promote the ingestion of fluids which are high in carbohydrate content (ie., fluid replacement drinks and cola drinks). So the question is raised as to whether D-glucose increases blood pressure and heart rate at rest and under stress.

The blood pressure and heart rate of each subject was measured at rest and under stress (written MENSA test). At 1-hour and 2-hour intervals after a glucose solution was given, the blood pressure and heart rate of each subject was measured again at rest and under stress. When the data was studied, the Systolic Blood Pressure, Diastolic Blood Pressure and Heart Rate showed increases at rest and under stress after the ingestion of D-glucose. The most significant increases were in Heart Rate at rest and under stress.

Since this basic research shows some evidence that D-glucose increases blood pressure and heart rate at rest and under stress, a link between increased amounts of D-glucose in man's diet and cardiovascular disease may exist.

#Merit Award - American Medical Association

OTC DIETETICS: PHASE II
THE ADMINISTRATION OF PHENYLPROPANOLAMINE HCl IN THREE SEPARATE CONCENTRATIONS

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Phase II of this experiment is based on original research already conducted. Purpose of Phase II is to isolate the actual ingredient in OTC dietetics which produces the side effects and weight loss in the test animals. Phenylpropanolamine HCI (PPA), therefore is the focus of this experiment. Four groups (low, intermediate, and high concentration and control) of 6 Wistar strain laboratory rats per group, 3 of each sex, were used to evaluate the accuracy of the test results. Behavioral studies were conducted to chart any noticeable activity change. In this test a 1m x 1m box with grid pattern was used. Urinalysis studies were conducted to observe any metabolic abnormalities caused by the dietetic. The animals were weighed once a week, and weight loss was recorded over the 90 day duration of the experiment. Upon completion of the experiment, a dissection and visual observation of the internal structure was performed. Results showed that through the use of the OTC dietetic, DEXATRIM (containing 75mg PPA), only partial weight loss occurred. Noticeable and destructive internal damage was found in a majority of the test animals. Final evaluation of this experiment will be conducted through the use of a Scanning Electron Microscope (SEM) and tissue examination conducted on organs preserved from Phase I and II. The purpose of using the SEM and tissue cultures will be to pinpoint the nature of the damage done by the PPA.

A COMPARATIVE STUDY OF THE PHYSIOLOGICAL EFFECTS OF TREADMILL EXERCISE TRAINING VS. SWIMMING EXERCISE TRAINING

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The purpose of this study is to determine if the physiological effects of exercise training are equal for swimming exercise and treadmill exercise in laboratory mice.

Seven groups of mice were used. Three groups ran on a treadmill three times a week for 10, 20, and 40 minutes, respectively. Three groups swam three times a week for 3½, 7, and 14 minutes, respectively. A control group received no additional exercise. Thirteen physiological factors known or suspected to be influenced by conditioning were measured in all groups during the experimental period.

Comparable results were found between the running and swimming groups although differences were found in individual tests between the groups, most notably food consumption, water consumption, and post-exercise metabolic rate. The differences were attributed to differences in heat regulation between the swimming and running mice and to varying intensities of stress reactions to the exercise.

An extrapolation of the data was made to compare the overall effects of the two forms of exercise. It was found that, based on the physiological measurements taken, the overall health of the running mice worsened after an initial improvement as the length of the exercise sessions increased. This pattern was attributed to stress levels in the mice reaching such a point during the exercise session that stress reactions to the exercise counteracted the effects of the exercise. No such pattern was found in swimming mice.

THE QUANTITATIVE COLORIMETRIC DETERMINATION OF TOTAL CALCIUM IN BLOOD SERUM

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The purpose of this project was, through experimentation and research, to relate to the readers the differences in the amount of calcium present in the blood serum of various age groups. The procedure involved the collection of healthy blood serum specimens and the use of the chromogenic agent O-Cresophthalein Complexone which reacts with calcium in an alkaline medium to form a purple color. The principle of light absorbance was then used to determine the amount of calcium present in each specimen. The maximum absorbance of the purple color is 575 nm on the Spect 20 and the intensity of the purple color was found to be proportional to the calcium concentration in the test specimen. These values were then compared to values run on the same specimens in a local hospital laboratory.

I was unable to make an analysis based on the blood serum samples I obtained. It was not possible for me to secure specimens from all areas of the spectrum of ages. Thus, my comparison was experimentally restricted to that of teen-agers and adults. I discovered no major difference between those two age groups based on my results. Through research I learned that the average for adults is between 8.5 and 10.4 mg/dL.

Research led me to conclude that the required amount of milk changes per day slightly because of variables such as the amount of calcium already stored in the body and the rate at which it is being absorbed. The difference in requirements is also related to the amount of growth within a particular age group.

DETERMINING THE FASTEST RATE OF TISSUE REGROWTH BY COMMERCIAL SKIN OINTMENTS IN STREPTOZOTOCIN-INDUCED DIABETIC MICE.

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It has been shown that in diabetics, the rate of tissue regrowth where wounds are present is slower than that of normal individuals. The purpose of this research was to examine the effect of various commercial skin ointments on diabetic mice as compared to normal mice, and to determine which ointment is most effective in promoting tissue regrowth.

In this experiment, one group of 8 mice was injected with Streptozotocin to induce diabetes, while the other group of 8 mice was injected with a citrate buffer as control. Under sterile conditions, a wound was inflicted between the shoulder blades of all 16 mice. Daily measurements of the wounds were taken. After each measurement, the first 4 mice of each group were treated with Mycitracin, Neosporin, Zinc Oxide, and Aloe Vera Jelly respectively. The 4 remaining mice in each group were used as control for the treated mice. The 1-4 mice were then compared with the untreated mice of their own group, and also to the treated diabetic mice.

The area of the wound of each mouse was calculated by computer, and then the percentage decrease in wound size, percentage of wound healing, was calculated. The daily average for each group was plotted and compared. This procedure was run 3 times, with a total of 4 mice in each group: Diabetic Treated, Diabetic Untreated, Control Treated, and Control Untreated. The results of this experiment show that normal mice do heal at a faster rate than diabetic mice. It also shows that all treated, diabetic or non-diabetic, mice heal faster than those that were not treated. In most cases, it was observed that Aloe Vera produced the highest incidence of wound healing in both diabetic and normal mice.

#STUDIES ON THE EFFECTS OF TEMPERATURE IN THE EYE

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Temperatures along the visual axis are the result of passive heat transfer or a consequence of an active adaptation to changes in temperature. The objectives of this study were to determine how hypothermia of the eye influences retinal temperature, to investigate whether or not the optic nerve affects temperature regulation of the eye, and to developed an in vitro system to test passive temperature conduction in the lens.

In Vivo Studies: Cats were anesthethizaed with Ketamine (25 mg/kg ip) and placed in an stereotaxic apparatus. Thermocouple probes were implanted in the retina, retrobulbar and conjunctiva. Ice packs, air tunnels and direct block contact were used for cooling purposes. Temperature in the retina was not affected by cooling of the eye. Transsection of the optic nerve had no effect on eye thermoregulation. Mechanisms that allowed temperature conservation in the retina as well as other sites were observed.

In Vitro Studies: Rats were killed by means of cervical dislocation. Lens were extracted, decapsulated. Spectrophotometric tests measuring turbidity were performed using several preservative solutions to stabilize the tissue tested. High temperatures increase opacity of the lens as indicated by a reduced % transmittance. Low temperatures produced opossite effects. This was the first quantitative study of the effect of a significant temperature change in the Lens in vitro. The results suggest that temperature may play an important role in tissue degradation in the Eye.

#Fourth Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

THE EFFECT OF VALIUM (DIAZEPAM) UPON MUS MUSCULUS IN ORGAN FUNCTION AND APPEARANCE AND IN PSYCHOLOGICAL ATTITUDES

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The purpose of this project was to determine if Valium (Diazepam) through injection causes any detrimental side effects, physically and behaviorally. Over a three year study, certain observations were made in both areas. This past year has dealt mainly with Valium's effects upon internal organs. Mice were paired off as two pairs of an injected male and a non-injected female, two pairs of an injected female and a non-injected male, two pairs of an injected male and female, and two pairs of controls. The mice being injected were administered 0.1cc of Valium.

After a period of time of four and one-half months, the injected mice were dissected, as were two offspring mice of the injected pair and also the control pair. After dissection, the organs were separated and examined. The organs removed were the liver, kidneys, spleen, heart, stomach, and testes if the mouse was male. Observations of these organs showed interesting findings. In one of the injected males dissected, the liver, stomach, and spleen were fused together and could not be separated. In both the injected females dissected, the right kidney was linked to the liver by a fatty-type tissue. Both these findings are unusual. Other findings showed a buildup of fat around the spleen of one injected female while another female had a yellowish growth on the liver similar to the growth found last year.

These effects, both physical findings of this year and behavioral findings of last year could be in direct relation to Valium injections.

LYSINE STIMULATION OF INSULIN SECRETION IN NON-DIABETIC RATS

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To understand the disordered insulin secretion that characterizes diabetes, normal insulin secretion in non-diabetic subjects must be known. Glucose, the product of carbohydrate digestion, directly stimulates insulin secretion in normal subjects. Amino acids, the metabolites of protein digestion, were also found to stimulate insulin secretion. This study attempts to determine two qualitative relationships between the intravenous administration of the specific amino acid, lysine, in non-diabetic rats and the corresponding insulin secretion that results. It was hypothesized that the intravenous administration of lysine to fasted, non-diabetic rats would stimulate an insulin dose-response such that serum or plasma insulin concentrations rise sharply, then decrease steadily until approximately original levels are again reached. Furthermore, it was hypothesized that greater doses of lysine stimulate greater secretions of insulin. It was possible to test both hypotheses simultaneously by injecting variable amounts of lysine into normal rats fasted for 24 hours, and taking blood samples both before and at specific time intervals after the injection. Insulin concentrations were determined by radioimmunoassay. Mean insulin concentrations following a 2.0 mmol/kg body weight injection of lysine rose 192% in three minutes then fell to within 4% of original levels in the next twelve minutes. Peak IRI concentrations following successively greater injections of lysine show, with some significant deviation, that there is a definite upward tendency with the insulin secretions in response to greater doses of lysine. The data tend to support the original hypotheses; however, since there was significant deviation in precision and accuracy, the results cannot be considered conclusive at this point.

THE EFFECTS OF IONIZING RADIATION ON THE LEUKOCYTIC RESPONSE OF A MALE LABORATORY MOUSE (CD-1 SPECIFIC PATHOGEN FREE)

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With the increase in production of nuclear arms by both the United States and the Soviet Union,the possibility of a global nuclear war also has increased;therefore,it is imperative to research and discuss the effects of such a conflict on humans and the environment in hopes of deterring its occurrence.Research conducted in the 1950's indicate that populations exposed to ionizing radiation from nuclear detonations generally developed hematologic disorders such as leukemia.This project is based on those findings and subsequent research.

The project is divided into three phases,with phases II and III having hypotheses dependent on each other as well as the hypothesis of phase I.In the primary phase,the occurrence of leukocytosis is to be proved after exposure to two dosages of radiation by two groups of mice. In phase II,an attempt to ascertain which leukocyte increases is to be made.In phase III,if lymphocyte count increases in phase II,then a lymphocyte immunoassay will be performed;however,if phagocytic cells are the cause for the increase,the phagocytic index will be utilized.

In the procedure facet of the project,a baseline white cell count and differential count are established by blood analysis,using the hemacytometer and Wright's stain techniques respectively.Blood samples are taken from minute incisions cut by scalpel at the end of the mouse tail. Radiation is administered by a cobalt radioisotope teletherapy emitter.

In conclusion,if the experiments result favorably,one may assume that due to the radiation,the immunologic defenses of any survivors might be depleted to such a point that they,being the survivors,would become highly susceptible to diseases that have been thought of as'long exterminated'.

#CANCER AND PROTEIN DEFICIENCY IN HUMAN SERUM

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Purpose

1. To investigate the presence and relationship between concentration of serum proteins and manutrition in human subjects with general neoplastic desease.
2. To measure the difference in response of three serum proteins to malnutrition.
3. To investigate the effect of cancer on concentration of serum proteins in the body.

Procedure

Concentrations of albumin, prealbumin, and transferrin incancer patients and in healthy control group were measured twice a week for a period of about 6 months and compared to the corresponding diagnoses of nutritional condition. Statistical analysis was made showing correlation between concentration of proteins and nutritional condition, difference in concentration of three proteins between experimental and control group, and degree of percentage variance of each protein in all cases studied.

Conclusion

Three serum proteins may be used as indices of presence and degree of malnutrition due to their high quality in reflecting it in cancer patients, with prealbumin being the most precise parameter of identification of malnutrition. Cancer patients were found to have a significantly lower concentrations of serum proteins than control group, suggesting a relationship between cancer and malnutrition, but according to variations cancer is not necessarily accompanied by malnutrition.

#Third Award - General Motors ISEF
Merit Award - American Medical Association

FACTORS INFLUENCING SELENIUM'S EFFECTS ON GASTROINTESTINAL CARCINOGENESIS BY EHRLICH ASCITES TUMOR CELLS IN MUS MUSCULUS

Moore, Pete, Wayland H.S., Wayland, MI 49348; 860 - 133 Ave., Wayland, MI 49348

For many years scientists believed selenium was carcinogenic. Though it is true that at high concentrations selenium is toxic, recent research has shown in minute concentrations (.1ppm) it is an essential nutrient. It has also been suggested that selenium might be anti-carcinogenic.

The purpose of this project is to determine whether selenium dioxide, seleno-DL-cystine, and seleno-DL-methionine are capable of slowing or inhibiting the growth of Ehrlich ascites tumors (EAT) in *Mus musculus*. This was accomplished by injection of .2ml of EAT cells which were tested for viability using a hemocytometer, into 30 ICR mice. Twenty-seven of these mice were treated with .25µg/g body weight, 1µg/g body weight, or 2µg/g body weight dosages of the 3 selenium compounds. The remaining tumor-innoculated mice was the control. Nine mice were treated with selenium for 10 days prior to being innoculated with the EAT cells to determine any lasting effects the selenium had upon the mouse organs. All tumors as well as accompanying ascitic fluid were excised, measured, and recorded.

The results of my experiment indicate that selenium is anti-carcinogenic. Selenium, when injected into mice innoculated with EAT cells, completely inhibited the formation of tumors. Selenium concentrated itself in the mouse organs and inhibited the formation of tumors even after treatment stopped.

FACTORS AFFECTING THE TRANSMISSION OF NERVOUS IMPULSES IN HUMANS

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The purpose of this experiment was to determine which factors affect the rate of reaction in human subjects. The results supported my hypotheses that younger, female subjects react faster than their counterparts and most subjects perform better with the hand they are accustomed to using. The remainder of my hypotheses was incorrect; taller subjects performed better than short, subjects with lower pulse rates outdid those with higher pulses, and most people reacted faster to visual stimuli than to auditory.

Lower reaction time of subjects with low pulse rates may be due to their physical condition. People in good condition have lower pulse rates and would probably react faster.

The increase in reaction time using an auditory stimulus may be due to the experiment's design. Although an effort was made to vocalize the command and drop the ruler simultaneously, the experimenter's reaction time could affect the results. However, the sensitivity of the eye and ear and the speed of sound and light may be factors. The eye is the keenest sense organ; light travels faster than sound.

The data, most difficult to explain, involve the subjects' heights. The design of the experiment could be a factor here, also. Since the experimenter's height remained constant, subjects might have positioned their eyes and hands differently according to the relative position of the ruler before it was dropped.

The results indicate that reaction time varies with age, sex, height, pulse rate, handedness, and stimuli.

#NEW DEVELOPMENTAL CHANGES IN NEONATAL RAT PLASMA LIPOPROTEIN-CHOLESTEROL

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Purpose: To find out if plasma total cholesterol levels of neonatal rats change with their degree of growth maturation and to determine whether any selective changes in plasma lipoprotein-cholesterol fractions occur during different periods of neonatal rat development.

Procedure: Mother rats were fed either a control low or experimental high cholesterol diet during nursing. Neonatal rat plasma total cholesterol levels were enzymatically determined in normal fed (normal-for-age), underfed (small-for-age) and overfed (large-for-age) suckling pups. Neonatal rat plasma lipoprotein-cholesterol fractions separated by cellulose acetate electrophoresis of normal fed suckling pups were measured at 0, 10 and 20 days of age employing an enzymatic stain.

Results and Conclusions: Neonatal rat plasma total cholesterol levels were found to depend on the degree of growth maturation, being highest in small-for-age, late maturing, immature rats. It therefore appears that the second half of neonatal rat development from day 10 to day 20 is a period of intestinal cholesterol absorption maturity with the intestine closing to cholesterol absorption, possibly due to the development of a presently unknown "maturation barrier" to intestinal cholesterol absorption. The present data also indicate that the first half of neonatal rat development is characterised by a 367% increase in plasma high density lipoprotein-cholesterol (HDL-C) rather than a large increase in plasma low density lipoprotein-cholesterol (LDL-C) as has been reported for human infants. On the other hand, the second half of neonatal rat development was found to be a critical period for a selective 42% decrease in plasma LDL-C rather than remaining constantly elevated as has been reported for human infants.

#First Award - United States Army
Second Award - General Motors ISEF

#THE DEVELOPMENT OF MONOCLONAL ANTIBODIES TO CLOSTRIDIUM BOTULINUM

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The recent development of hybridoma technology offers the oppurtunity to greatly improve the antibodies used in treating food poisoning cases caused by the bacterium, *Clostridium botulinum*. The production of monoclonal antibodies by hybridoma techniques involves the genetic fusion of conventional, toxin antibody cells and cancer myeloma cells. The resulting hybrid cells multiply rapidly, characteristic of the cancer cells, and carry the antibody cell properties. Conventional serums are crude mixtures of impure antibodies with contaminants that are not easily detected. Monoclonal antibodies, however, are pure because the researcher can screen out those hybrids formed from contaminants, and thus are more effective. The initial fusion process was successful in yielding two clones carrying the antibody characteristics. Further research is being conducted to stabilize the two clones.

#Third Award - General Motors ISEF

HOW CARBON MONOXIDE AFFECTS ANIMAL BLOOD

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No abstract received.

STUDY OF THE MOLLUSCICIDAL PROPERTIES OF *SOLANUM TORVUM* IN *LYMNEA COLUMELLA*, HOST OF *FASCIOLA HEPATICA* IN PUERTO RICO

Carrión, Anthony R., C.R.O.E.M. High School, Mayaguez, P. R. 00708;
P.O. Box 29, Luquillo, P. R. 00673.

The presence of *Fasciola hepatica* in the biliary veins (trematod in leaf form) like its name is not a parasitic infection for man, except in places where all conditions are found that make it easy for infection to occur, turning the parasitosis into a medical and public health problem.

In the laboratory, the molluscicidal properties of the leaf extracts of *Solanum torvum* (berenjena cimarrona) in *Lymnaea columella*, host of *Fasciola hepatica* in Puerto Rico, were analyzed. The criteria established for the selection of the plant were: toxic to mammals, found near the habitat of the mollusks and belongs to the Solanaceas, a family of toxic plants.

The study revealed that the plant was too toxic to *Lymnaea*, because in concentrations of 200 to 1,000 p.p.m. all snails died. Leaves were used because of their greater concentration of alkaloids, that are toxic compounds.

It is postulated that this mollucidal plant could be used in the control of the biological life cycle of *Fasciola hepatica* and other diseases carried by snails.

MICROBIOLOGY

#SOME LIKE IT HOT

Britton, Romie Lynn, Grants H.S., Grants, NM 87021;
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To test chili, all parts of a long green chili, jalapeno, red chili and Hungarian yellow chili were ground up and tested on the bacteria *Bacillus subtilis* and *Serratia marcescens*. The parts were then BOILED, TESTED WITH Benedict's solution, evaporated, allowed to stand for 24 hours, then the chili extracts from the above experiments were tested on both types of the bacteria.

Semi-purified protein extracts produced by precipitation and chromatograms were tested on *Bacilus subtilis* and *Serratia marcescens*.

Parts from the long green chili and the jalapeno killed the bacteria, while no killing agent was present in the other two chilies. The chili that was boiled for 15 minutes, left at room temperature for 24 hours and tested on the bacteria all had negative results. The ninhydrin test of the chili extracts were positive, thus indicating a protein type molecule. Chromatography separations indicated a free amino group was present.

Through a spectrophometer and a DEAE cellulose column the killing agent was found to have a negative charge.

70,000 atomic mass units was found to be the molecular weight of the chili. Through purification and dissolving of chromatography, the chili was found to indeed be a protein. However, one molecule was a protein, while another molecule in the chili was unknown.

Through the Buechi and Hippenmeir method chili was found to have capsaicin, however it was not determined while in solution form. Alcohol was then used as the solvent and capsaicin was found to be present, thus the killing agent has been separated and identified.

#First Award - American Medical Association

#EFFECTS OF 1011 MEGAHERTZ MICROWAVE RADIATION ON BACTERIAL SYSTEMS

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10321 Little Sugar Creek, Converse, TX 78109

A current scientific debate concerns the thermal vs non-thermal effects of microwave irradiation of living systems. *Escherichia coli* strains C-600 (lac^-) and V-517 were exposed to about one GHz microwave radiation at field intensities of approximately 400 mV/cm^2 for 10 min. in a high dielectric salt solution which yielded temperatures of 35-50°C. Control cultures were exposed to the same temperature and time levels in a water bath. Thermal survival and adaption curves were developed for progeny of untreated and microwave-treated cells. Significant changes were noted in both strains following exposure to microwaves. For example, a microwave exposure resulting in a temperature of 40°C yielded about 40% of the population being altered in (1) motility, (2) anaerobic metabolism, (3) biochemical characteristics, (4) colony morphology, (5) pigmentation of agar media, and (6) thermal growth optima. Electropherograms of plasmid DNA of untreated and microwave treated cells were identical. These preliminary results suggest that microwave irradiation of *E. coli* cells under specified conditions produce permanent phenotypic changes.

#First Award - General Motors ISEF
Second Award - United States Air Force
Honorable Mention - American Society for Microbiology

#THE CHARACTERIZATION OF A CONJUGATIVE PLASMID IN *ESCHERICHIA COLI*--PHASE II

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Plasmids are autonomously replicating genetic elements existing independent of the bacterial genophore; however, some can integrate into the bacterial chromosome. Two *Escherichia coli* strains, donor HT-99 (F+) and recipient J-53R (F-), were employed in the research. HT-99 houses a conjugative plasmid of approximately 60 megadaltons conferring chloramphenicol-resistance, but it is rifampicin-sensitive whereas the latter strain carries a chromosomal gene for rifampicin-resistance; however, it is chloramphenicol-susceptible. Recombinants were also utilized which are resistant to both antibacterial agents. A transconjugant is merely a J-53R which has secured the HT-99 plasmid.

The principal objective of this experiment was to disclose additional plasmid-mediated genes residing on the donor's plasmid through the use of extensive antibiotic and biochemical assays for each strain and the recombinants. Beforehand, numerous methodologies were studied and applied to optimize plasmid transfer. First, the minimal incubation period required to achieve a bacterial suspension in the logarithmic stage of growth was determined. Moreover, the mating efficiency of the donor or the recombination frequency was calculated.

Experimental data indicate an erythromycin-resistant determinant in addition to a chloramphenicol-resistant gene on HT-99's plasmid. Further investigations will involve the testing of heavy metals and more chemotherapeutic agents. Also, other substrate utilization studies and a chromosomal mapping of the donor will be performed.

A major application of this research is to aid in the better understanding of the development of antibiotic-resistant strains arising from plasmid transfer due to antibiotic misuse in our society.

#First Award - American Veterinary Medical Association
First Award - American Society for Microbiology
Second Award - General Motors ISEF

#GENETICS OF BACTERIA-PLANT INTERACTION: TRANSFER OF NODULATION PLASMID BETWEEN *RHIZOBIUM* SPECIES

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1555-B Meyers St., Honolulu, HI 96819

Microorganisms of the genus *Rhizobium* form nodules on the roots of legumes and convert atmospheric nitrogen into nitrogen compounds. *Rhizobium*-legume symbiosis is marked by extreme specificity due to the genes carried by plasmids. I have transferred the plasmid pJB5JI, donated by *Rhizobium leguminosarum* 6015(pJB5JI), into *Rhizobium trifolii* and examined the symbiotic properties of the transconjugants. Transconjugants made with Nod$^+$ *Rhizobium trifolii* 0403 could effectively nodulate clover and ineffectively nodulate peas. However, the transconjugants made with a cured Nod$^-$ *Rhizobium trifolii* was highly effective on peas but still Nod$^-$ on clover. The identity of the donors, recipients, and the transconjugants were confirmed by immunofluorescence and immunodiffusion using strain specific antisera.

In this study, I have shown that plasmid pJB5JI can be transferred to another *Rhizobium* species. However, its symbiotic effectiveness depends on the genetic background of the recipient species.

#Third Award - General Motors ISEF

#REPORT AND STUDY OF NEW ANTIMICROBIAL NATURAL PRODUCTS FOUND IN THE FRUITS OF SOLANUM MAMMOSUM

Colón, Marcelo, Antonio S. Pedreira H.S., Caguas, P.R. 00625
Bo. Jaguas Bz. 280, Gurabo, Puerto Rico 00658

The plant Solanum mammosum grows wild in Puerto Rico where it is known as "berenjena cimarrona". The mature fruits of this plant have been used by people of Puerto Rico as an agricultural insecticide, and have been also reported to be highly toxic when consumed by animals. The aim of the present investigation was to study antimicrobial activity of organic extractions from fruits of this plant. The emphasis was on the isolation, purification, and characterization of the specific chemical compounds responsible for any antimicrobial activity.
Extracts from fruits were found to be highly active against sixteen species of bacteria and three species of fungi tested. Subsequent purification showed that the active principle was related with the glycosidic alkaloid content of this plant. This material on column chromatography revealed the presence of solasonine ($C_{45}H_{73}NO_{16}$) and solamargine ($C_{45}H_{73}NO_{15}$) which were identified by melting point, formation of their picrate salts, and their reduction to solasodine by acid hydrolysis. Solasodine ($C_{27}H_{43}NO_{2}$), m.p. 197°- 198°C, was identified by mass spectroscopy, nuclear magnetic resonance and infrared spectroscopy.
Solasodine was found to be more active than its glycosides, having minimal inhibition concentrations from 3 to 8 mcg/ml. Since the activity of solasonine or solamargine was very similar to that of solasodine, it was assumed that the sugar component has no particular activity of its own. Further analysis demonstrated that the presence of the NH group in the structure of solasodine plays an important role on its antimicrobial activity. Killing curves of the isolated compounds as new antimicrobial agents will be discussed.

#Second Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration
Meritorius Award - United States Army

#A MICROBIOLOGICAL ANALYSIS OF PETROLEUM PROCESSING BACTERIA
PHASE II

Taylor, Kim E., Kaycee H.S., Kaycee, Wyoming 82639;
P.O. Box 126, Kaycee, Wyoming 82639.

This project is involved with attempting to find a micro-organism which could grow on a petroleum base and produce a usable by-product from fossil fuels. The proposal is not to create an alternative to fossil fuels, but to attempt to extend the longevity of these resources. By locating and developing a bacterial strain that is capable of producing useful by-products from previously depleated fields, we can perhaps increase the longevity of our fossil fuel supplies. In doing this project, it is believed that a bacteria of this type can be found and grown in a laboratory environment. It is also believed that this bacterial strain can be beneficial to mankind through practical applications. The importance of such a discovery in todays energy-short world would be of obvious significance.

#Third Award - American Association of Petroleum Geologists
Fourth Award - General Motors ISEF
Honorable Mention - Gulf Oil Corporation

#MICROBIOLOGICAL STUDIES OF VARIOUS FUNGI SPECIES ACTING AS BIOLOGICAL CONTROL FOR PHYTOPHTHORA INFESTANS

Román Irizarry, Elsa J - Dr. Pila High School - Ponce PR 00731
Rep. El Valle Calle A 7 A - Bo. Magueyes Ponce 00731

The main purpose of this investigation is determine the capacity of various funge to fight biologically P. infestans, patogenic mold which causes late blight illness in the plantation of tomatoes in Puerto Rico.

The hypothesis is based in the fact that in the natural environment various fungi species could be used in a positive way to control biologically P. infestans.

A series of fungi were selected from the natural environment specially from the soil in vegetable gardens. These kind of fungi are classified taking in to consideration their system of filaments, or hiphae and spores. The molds that were used for this study were: Cladosporium sp., Trichoderma sp., Aspergillus sp., Curvularia sp. and Penicillium sp.

The method used was one to insolate a pure culture media and a sowing technique in surface plate. Once, the culture is considered pure, the patogenic mold like the possible controls were established. Them a sample of patogenic fungi is place (P. infestans) in one of the extremes of the divisory line and the possible control at the other extreme. Two witness were prepared, one from P. infestans and the other from the possible control.

To check the results in establishing the controls, the distance were measured in centimeters from the growth of the evidence. Thus it was found that the studied fungi, Aspergillus sp., Trichoderma sp. and Penicillium sp. have the capacity to control biologically in vitro P. infestans. Menwhile, the Cladosporium sp. and Curvularia sp. dont' posses this property.

#First Award - American Phytopathological Association

#THE EFFECTS OF LEAD ON BACTERIA

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6608 Cochise Dr., Knoxville, TN 37918

Ever since the Industrial Revolution, the concentration of lead has steadily increased. The purpose of this project is to determine what affects the rising lead concentrations has on a very important part of the ecosystem, the bacteria. Bacteria was chosen because without bacteria many functions necessary for the life of the ecosystem would be impossible. If the bacteria were affected, then the whole ecosystem would probably be affected. The bacteria used was Escherichia Coli, a common type of bacteria.

The first step was to determine lead effects on bacterial growth. Due to the complexity of the broth used the lead ions reacted with the broth and formed a precipitate. The next step taken was determining the lead concentration in a pond. This was done by taking mud samples and analyzing them by x-ray flourescence. The result was 52.96 ppm lead. The next step was to test lead effects on bacterial metabolism. This was done by measuring the effect of 5ppm, 50ppm, and 250 ppm lead on the bacterial respiration. With only 5ppm lead, there was a drop of 62.1% normal respiration rate, with 50ppm lead a drop of 83.3%, and with 250ppm lead a drop of 89.4%.

The results of these experiments show that more attention should be shown towards lead pollution, especially from car exhaust.

#Fourth Award - General Motors ISEF
Alternate Award - U.S. Department of Energy

A COMPARISON STUDY OF GERMICIDAL FUNCTIONS INHIBITING BACTERIAL GROWTH

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The purpose of this study was to determine the inhibiting effects of various cleansing functions on bacterial growth on dishes. The variables were washing methods, temperature, detergents, types of automatic dishwashers, chlorine in the rinse waters, and time left to set after washing was completed.

The tests determined how well the inhibitory functions worked: 1. Dinner plates were subjected to varying amounts of chlorine in the rinse waters in both of the washing methods. 2. Dinner plates were subjected to three differing temperatures in the hand wash water. These temperatures were tested in each of three detergents. 3. Dinner plates were subjected to actual hand and automatic washing methods. 4. Dinner plates were subjected to three detergents in the automatic washer. 5. Dinner plates were subjected to three lengths of time left to set on the drain board and the drainee in the automatic washer. 6. Dinner plates were subjected to different types of automatic washers. The streaking method was used to transfer the bacterial specimens from the dishes to the solid medium - - blood agar.

The growth was recorded on days 2 through 5. (Observation on day 1 showed no growth)

It was concluded that automatic dishwashing inhibited growth better than hand-washing. Cascade was the best detergent in both of the washing methods. As the temperature in the waters increased the amount of growth decreased. Adding chlorine to the rinse waters decreased growth considerably. And, as the time left to set in the drainers increased, the bacterial growth increased considerably.

DMSO ENHANCEMENT OF STANDARD KARYOTYPING TECHNIQUES

Groves, Leonora J., Richwood High School, Richwood, WV 26261;
P.O. Box 288, Richwood, WV 26261.

The purpose of this research was to investigate staining techniques in karyotypes and determine if DMSO (dimethyl sulfoxide) could replace methanol in standard Giemsa staining. DMSO has the ability to penetrate membranes without causing irreversible damage. Thus, the hypothesis of this research was that DMSO would penetrate chromosomes acting as a solvent vehicle for stains to enhance staining in standard karyotypes.

Efficient karyotyping methods were used to produce uniform spreads for investigation of chromosomes. The procedural steps include: withdrawal of peripheral blood, planting peripheral blood, harvesting leukocytes and preparing slides. Nonstained slides were first examined under a phase contrast microscope and suitable spreads were recorded. These slides were used to compare their stainability under the same conditions.

It was determined that DMSO served as a suitable and reliable solvent vehicle for Giemsa stain. Best results of higher quality staining than standard Giemsa staining were obtained within a pH range of 5.63 to 8.65. Standard Giemsa staining is impeded by a very specific pH of 6.8 ± .1, and resulting chromosomes are not as darkly stained as in DMSO supplemented Giemsa. Pure DMSO was also found to greatly enhance and simplify the standard destaining technique used in cytology labs at the present.

VARIABLES AFFECTING MUELLER-HINTON TEST FOR ANTIMICROBIAL SUSCEPTIBILITY

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6458 Dianne St., Shreveport, La. 71119

A variety of laboratory techniques can be used to measure susceptibility of bacteria to antimicrobial agents. An antimicrobic is a chemical that kills or inhibits the growth of microorganisms. In most laboratories, an agar diffusion method is used routinely for testing common rapidly growing bacteria. If results are to be reliable, the details of these procedures must be carefully standardized.

Of the many media available, Mueller-Hinton agar is the best and most reliable for routine susceptibility testing. This agar is basically not enriched and has no blood products. A large amount of data has been collected on the usage of Mueller-Hinton agar and it gives satisfactory growth of most pathogens.

In my experiment I chose ten variables to test against the standardized procedure. I used the organism, staph epidermis. These ten variables are turbidity of the inoculating solution, time between inoculating the culture medium and application of the antimicrobic discs, incubation temperature, agar type, CO_2 concentration, agar thickness, premature reading of test results, heavy inoculum, unsatisfactory storage of medium, and use of expired or outdated medium.

I concluded from my test that variables do affect the Mueller-Hinton test for antimicrobial susceptibility by causing the zone sizes to increase, decrease, or vary to some extent, thereby giving evidence for necessity of a standardized procedure.

#THE INFLUENCE OF CADMIUM ON GROWTH AND MORFOLOGY OF THREE SPECIES OF NEMATODE-TRAPPING FUNGI

Grip,Märta ,Katedralskolan,Lund,Sweden
Östra Torn 18,22368 Lund,Sweden

In this research three species of nematode-trapping fungi were grown in a serie of cadmiumconcentrations.The species of fungi were:Arthrobotrys oligospora,Arthrobotrys superba and Dactylaria candida.The diameter of the culture were measured daily.Finaly the morfology of the fungi was studied and also the number of traps.After an addition of nematodes (a kind of soil-living worm) the capacity of the traps were gauged.With the intention of learning if cadmium had any quantative affect on the traps ,a randomisation was done. The results were that the growth of the fungi were strongly inhibited by cadmium and that the number of traps were reduced.The ecological meaning of this is that an increased percentage of cadmium in the soil results in a decreasing amount of nematode-trapping fungi.This allows the nematodes to become numerous.Some nematodes are plant parasitic and would cause a harvestloss.We have therefore an interest in keeping the concentration of cadmium in the soil as low as possible.At present,is there no good method for measuring the percentages in field,as cadmium exists in different forms in soil.More over it is not known which forms are the dangerous ones to the nematode-trapping fungi.What is known is that cadmiums toxicity is reduced on clay and humus rich soils.I have made a calculation on the present percentage of cadmium in the soil.It is alarming results, something must be done to improve the sitution.for the organisms of the soil.

#Second Award - American Phytopathological Association

INACTIVATION OF LPK BACTERIOPHAGE BY PHENOLIC EXTRACTS FROM COMMERCIAL GRAPE JUICE

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In 1976, a report was published describing the inactivation of various enteric viruses and herpes simplex virus by commercial grape juice and other grape products. Since the phenolic content of all grape products has long been calculated by many scientists, the study assumed a strong relation between the higher phenolic content of commercial juice (in comparison to the other tested products) and the noticeable inactivation of animal viruses. Due to its ease in cultivation, LPK bacteriophage was utilized in 1982 in experiments designed to determine whether phenols derived from grape juice are directly responsible for viral inactivity. The study was divided into two phases; the first phase involved extracting phenols from the juice through the use of sodium hydroxide and ethyl ether, testing these products on the phage, testing natural whole grape juice, and testing a saline control. The second phase consisted of another saline control test, a neutral whole juice test, and a neutral liquid phenol test. Average titers for each test were obtained and used to calculate the percentage inactivation caused by each substance in comparison to its respective control. After the data was analyzed, it was concluded that the phenolic extraction procedure was incorrect or the phenol types of grape juice and aqueous solution are different. Further detailed and large-scale experiments are necessary to determine whether phenols derived from grape juice are directly responsible for viral inactivity.

#A STUDY OF THE INHIBITORY EFFECT OF SOME TROPICAL PLANT EXTRACTS ON SEVERAL BACTERIA

Meléndez, Peter, Colegio San Antonio, Isabela, P. R. 00662;
Ensanche González #87, Isabela, P. R. 00662.

The main objective of this study is to investigate the possible inhibitory effect of 100 tropical plants over 18 species of bacteria. Leaf extracts of all plants were tested for inhibitory action. Fruit extracts of all positive plants were also tested.

All plants were collected from the northwestern region of Puerto Rico. Methanolic extracts of all plants were made. All bacterias were cultured in nutrient agar and nutrient broth. Bacterias were transferred to the Petri plates using standard inoculation procedures. Extracts were applied using Difco Concentration Disks. Proper controls of a nutrient agar plate, agar plate with discs containing extracts but no bacterias, plates with discs without ether extracts or bacterias and plates with an extract spread were carried out simultaneously. All plates were incubated at 37ºC. The inhibitory effect was determined on the basis of the size of an inhibition zone measured in mm. Comparison of positive extracts with known antibiotics was also carried out. Both gram+ and gram- bacteria were used.

Of all 100 plants, 7 gave positive results. These were: Punica granatum (fruit) over 6 bacteria, Citrus aurantifolia (fruit) over 14 bacterias, Citrus aurantium (fruit) over 12 bacterias, Phyllanthus acidus (fruit) over 8 bacterias, Crescentis cujete (leaf) over 4 bacterias, Melicocca bijuga (leaf) over 1 bacteria and Rosmarimes officinalis (leaf) over 3 bacterias.

#Third Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

BACTERIOLOGICAL CONTAMINATION IN THE CRASSOSTREA RHYZOPHORAE GUILDING OF BOQUERON

Ortiz, Augusto H., Luis Muñoz Marín H.S., Cabo Rojo, P. R. 00622;
Luiz Muñoz Rivera, Boquerón, Cabo Rojo, P. R. 00622.

In this bacteriological investigation of the waters of Boquerón Bay we found a high degree of contamination with Escherichia coli, Enterobacter (both reveal the presence of human feces), Bacillus epihytus and Planococcus citrious. Bacterias were cultured in E.M.B. and nutrient agar.

The waters surrounding the oysters, Crassastrea rhyzophorae Guilding in Boqueron were analyzed. The water inside the oyster shell was also analyzed. Cultures showed the same bacteria mentioned above in both places. Other media such as glucose, monnitol, T.S.B., etc. were used in an attempt to identify all bacteria found.

It has been shown that Crassostrea rhyzophorae represents a small system of water purification. It can remove bacterias if these are not present in large numbers but when the bacterial count is high, they can not purify the water. The bacterias do not seem to affect the oyster.

THE EFFECT OF NEGATIVE IONIZATION ON AIRBORNE BACTERIA

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In my project I was trying to find what effect negative ions have on the precipitation of airborne bacteria.

I found that when Petri dishes were opened in two chambers (one a control chamber and one a negatively ionized chamber), exposed to airborne bacteria, and then closed and placed in an incubator for 48 hours, the plate inoculated in the control chamber grew eight times as many colonies as the plate inoculated in the ionized chamber. The negative ions reduced the number of colonies by 87%. From this I concluded that negative ions do precipitate bacteria out of the air.

The significance of my finding is very valuable if my conclusions are correct. Negative ion generators could be used in hospitals to eliminate harmful bacteria from the air. They would be specifically useful for burn patients, who have a high risk of getting bacterial infections during healing.

NATURAL ANTIBIOTICS AND BACTERIA

Whitmer, Michael L., Davenport Central High, Davenport, IA 52803
924 E. High Street, Davenport, IA 52803

Today, more and more antibiotics are being produced synthetically or semi-synthetically in the laboratory. In this project, the idea was to reaffirm that antibiotics in their natural forms can inhibit the growth of bacteria. To do this, a procedure had to be devised in which the mold or any other dry substance could be applied to the cultures under neat laboratory conditions. The problem was solved by dissolving the molds in ethyl alcohol. Another problem arose after a first trial had been executed. The bacteria had been stored on the agar overnight in a refrigerator before the discs were applied. This killed some of the bacteria and allowed the rest of the bacteria a chance to establish colonies; so during a second trial, the discs were applied immediately after the bacteria was. Both tests confirmed that antibiotics are inhibitory to the bacteria in their natural forms.

THE EFFECT OF SODIUM THIOSULFATE ON THE GROWTH RATE OF CHLORELLA MEASURED BY THE SPECTROPHOTOMETER.

Johnson, Deborah J., Davis High School, Kaysville, UT 84037; 462 S. 200 E., Farmington, UT 84025.

Chlorella is a single-celled algae which may prove to be an important factor in producing food and oxygen in future space and undersea travel, as well as an inexpensive and abundant food supply for a growing world population. The purpose of this experiment is to determine how varying percentages of nutrients affect the growth rate of chlorella. This experiment uses sodium thiosulfate as the initial nutrient. The equipment and procedures used are as follows:

1. Neon lighting (fabricated sunlight)
2. Thermometer (to measure constant temperature)
3. Aerator (to insure proper air circulation)
4. Small mouthed Pyrex glass jars (to contain solution with chlorella)

I prepared nine percentages of sodium thiosulfate by weight starting at .07%, .05%, .03%, .01%, 0%, 1%, 3%, 5%, 7%. Into this solution I introduced a minute amount of chlorella. To determine the rate of growth, samples from each concentration were tested by the spectrophotometer approximately every six to nine days. In conclusion, the sodium thiosulfate at low concentration increased the growth rate somewhat. Through my research I concluded that additional nutrients are necessary for maximum growth. In future experiments I plan to introduce additional nutrients until the ideal growth conditions can be found.

#STUDIES ON THE NATURE OF TETRAPOLAR INCOMPATIBILITY FACTOR IN PLEUROTUS OSTREATUS AND PLEUROTUS SAJOR-CAJU MUSHROOMS

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In these experiments, the nature of tetraspolar incompatibility factor systems in several strains of Pleurotus ostreatus and Pleurotus sajor-caju mushrooms was determined. Experiments to induce monokaryotic fruiting were subsequently performed, in order to test the relationship between incompatibility factors and spore production.

In order to determine the nature of these factors, basidiospores were isolated, grown into cultures and mated in all possible combinations. Compatible cultures showed clamp connections and were thus identified.

Monokaryotic fruiting was induced by growing the cultures on grain in conditions of high relitive humidity, good airation, and ample light.

All strains tested possessed tetrapolar incompatibility factor systems and monokaryotic fruiting can be induced and used to form sporeless mushrooms.

#Fourth Award - General Motors ISEF

THE EFFECT OF CALCIUM PROPIONATE ON DEVELOPING BREAD MOLD COLONIES

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The purpose of this project was to determine the effect of calcium propionate (a preservative) on developing bread mold colonies.

I began my experimenting by making three pure cultures of different species of bread molds. For each of the investigations there were four different levels of the preservative in sabouraud dextrose agar-none, 0.01%, 0.02% and 0.03% (investigation I) and none, 0.1%, 0.2% and 0.3% (investigation II). I traced the colony size daily then photocopied my results, cut them out and weighed them on a microbalance with a sensitivity of ten micrograms. Then ratios were made concerning the growth rate. Some conclusions were based on visual observations.

My results were that calcium propionate delays spore formation. Calcium propionate affects the growth rate but not significantly in various levels of it.

I concluded calcium propionate affects the asexual stage and it affects the growth rate greatly enough to differentiate that the preservative was present.

It is evident that the fact calcium propionate affects the asexual cycle is important. If a preservative that both inhibits the starting of a bread mold colony and hinders the growth rate excellantly was found, commercial bakeries and home kitchens with preserved bread would be safer from wide spread mycotoxins and fast-growing molds like Neurospora.

POPULATION DYNAMICS OF YEAST CELLS

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How do the metabolic processes of yeast cells influence the population growth of the whole culture? This investigation involved a study of the growth rate, peak and decline in population numbers of yeast cells in a sugar media. Typically, most growth curves in closed systems show a bell-shaped curve, slow start, rapid climb, peak, slow decline and then a rapid decline to almost the death of the culture. Metabolic wastes, lack of food, overcrowding all influence this type of population growth curve. The question that arises is, what causes the rapid decline?

Several sugar solutions of various amounts of sucrose and glucose in separate cultures were incubated with dried yeast. Everyday, a population count of the yeast cells was made using a Hoemocytometer over a fourteen day period. Along with this, a pH meter was used to test for changes in the pH and every other day a small sample was filtered and fixed to test for alcohol content using a gas chromatograph.

The results showed a cycling affect as the population numbers with changes in pH and alcohol content. As pH dropped and alcohol content increased the population numbers declined. For some reason the yeast cells began to grow again, pH increased slightly alcohol content decreased. This cycling effect continued throughout the cultures with .1 gram and 1 gram sugar. But the cultures containing the higher amounts of sugar, 5 gram and 10 gram showed more peak and decline.

Further studies have to be made in finding out exactly what all of the metabolic products produced by the yeasts are and how they influence larger sugar concentrations.

EFFECTS OF HIGHER PLANT HORMONES ON THE GROWTH OF ALGAE

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The intent of this project was to reveal the effects of the higher plant hormones (indole-3-acetic acid, gibberellic acid, and kinetin) on the reproduction and growth rate of the algae *Selenastrum* and *Scenedesmus*. Also, this project was used to find what media coupled with the hormones proves to be the best growing culture for *Selenastrum* and *Scenedesmus*.

Indole-3-acetic acid, in higher plants, causes elongation of plant cells and kinetin is a reproductive hormone in higher plants. The three solutions coupled with the hormones to make the culture media were Bristol's solution, a special growing solution for green algae; sterlised pond water, gathered from a pond at school; and distilled water.

There were two sets of cultures allowed to grow; the control group which had no hormones and the experimental group which had hormones. A photrometer was used to measure the optical density of the cultures, thus telling which of the cultures was growing better. This data was transferred to graphs to be used in the comparison of the growth of the cultures.

In conclusion, indole-3-acetic acid, gibberellic acid, and kinetin did increase the growth and reproduction rate of the alga *Selenastrum*. The experiments with *Scenedesmus* are inconclusive to date.

#BIOLOGICAL STUDIES OF NITROGEN FIXING AND ANTIBIOTIC PRODUCING MICROORGANISMS ON LEGUME AND NON-LEGUME PLANTS

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My project this year is a continuation of last year's. The purpose of the first phase of my experiment is to determine if nitrogen fixing bacteria, such as *Rhizobium meliloti*, Azotobacter, and Spirillum will provide as much or more nitrogen to alfalfa, wheat, oats, and corn as N_2 fertilizers. In June I planted a 178 ft. x 2,640 ft. test plot of wheat, oats, and corn. The rows consisted of Negative Control, Azotobacter & Spirillum, and 28-29-0. In the alfalfa test plot the alfalfa was inoculated with *R.meliloti*. Based on the results of the protein analysis, recorded growth, pictures, and grain yields, I can conclude that there is a good possibility that *R.meliloti*, Azotobacter, & Spirillum in the future will be able to be used as substitutes for N_2 fertilizers. Many factors may inhibit the growth of these nitrogen fixing bacteria, such as the use of fungicides to control diseases. The purpose of the second part of my experiment is to determine if a bacteria naturally found in the soil such as the biological antagonist *Bacillus licheniformis* will successfully inhibit the growth of *Pyrenophora tritici-repentis* as effectively as fungicides. *B.licheniformis* *P.tritici-repentis*, and Manzate 200 were inoculated on pots of Waldron spring wheat at different intervals. My conclusion indicates that *B. licheniformis* will successfully produce antibiotics and inhibit the growth of *P.tritici-repentis* as effectively as fungicides. This leads to the possibility of being used as a substitute for fungicides.

#Second Award - United States Navy
Third Award - General Motors ISEF
Honorable Mention - American Society for Microbiology

ISOLATION / SEPARATION / MUTATION OF STAPHYLOCOCCUS AUREUS AND STAPHYLOCOCCUS EPIDERMIS

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Every time a doctor prescribes an antibiotic,the day when it will become ineffective comes a little closer. More and more often bacteria that are resistent to antibiotics are being found. This is a problem of major medical concern. Once a bacteria has become resistant to an antibiotic it can pass its immunity to another bacteria. This process is conjugation. In this fashion, a harmless bacteris that is resistant to Penicillin can pass its immunity to a harmful bacteria that is not resistant to penicillin.

I chose S.Aureus and S.epidermis for two resons: 1) Both are from the same genus, 2) Both are found in or on the human body. The most common infections caused by S.Aureus include pimples,boils,carbucles & Impetigo. S.epidermis is commonly found on the skin & mucous membranes. S.epidermis causes minor lesions, especially with stitch abscesses. I chose the antibiotics: Ampicillin,Cephalothin,Erythromycin, Penicillin, and Tetracycline. The antibiotics affect the cell wall and the cell nucleus.

My testing consisted of three parts: A) I grew and isolated resistant strains of each bacteria, B) I tested the resistant strains with the other antitiotics, and C) I compared Hospital-isolated strains to the resistant strains from part A. The Hosp.-isolated strains were obtained from McKay-Dee and Hill Air Force Base Hospitals.

37°C was the Temperature at which testing was conducted,the sensitivity disc procedure was the method used in testing. The inhibition zones were measured in mm. The size of each zone was measured from the outside of the antibiotic disc to the nearest bacteria.

From these tests I found that cephalothin was the best inhibitor.

IDENTIFICATION OF CONJUGALLY TRANSFERRED R6K PLASMID DNA MARKED WITH AMPICILLIN AND STREPTOMYCIN RESISTANCE IN ESCHERICHIA COLI

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The objective of this research was to correlate the acquisition of antibiotic resistance (to ampicillin and streptomycin) through conjugation, i.e., the transfer of genetic material via cell wall to cell wall contact, to the presence or transfer of the theorized membrane bound R6K plasmid DNA. *Escherichia coli* cells contaning a fertility factor (F+) and R6K plasmid DNA (resistance to ampicillin and streptomycin) were conjugated with cells having no fertility factor (F-) or resistance to both antibiotics. This produced cells (exconjugates) having characteristics of both the donor cell (F+) and the recipient cell (F-) including antibiotic resistance to ampicillin and streptomycin.

Selective plating followed conjugation producing pure cultures of the exconjugates. The isolated exconjugates were then grown up in L-Broth in the presence of ampicillin and streptomycin. The DNA of the donor cell, recipient cell and the exconjugate was then isolated, extracted, and analyzed. The analyses of the DNA included gradient studies, agarose gel electrophoresis, and electron microscopy. Two types of gradient studies were employed: Cesium Chloride - Ethidium Bromide which is an equilibrium velocity gradient and Cleared Lysate on Sucrose (CLOS) which is a linear velocity gradient.

Results from these studies identified the transfer of genetic material from the donor cells to the recipient cells and therefore to the exconjugates.

THE EFFECTS OF MICROWAVE ENERGY ON SELECTED BACTERIA

Bartley, Jon J., Wamego High School, Wamego, Kansas 66547
R. R. 2, Wamego, Kansas 66547

Because of the convenience of faster cooking and the increasing popularity of microwave ovens it becomes more important to know the effect of microwave energy on microorganisms. It is the purpose of the researcher in this project to determine the effect of microwave energy on three selected bacteria, *Straphylococcus epidermidis*, *Escherichia coli* and *Pseudomonas fluorescens*.

Petri dishes of brain heart infusion agar were inoculated with each of the three selected bacteria, allowed to grow, colonies counted, and submitted to microwave energy for three twenty seconds time periods with a three minute interval between each twenty seconds. The bacteria was plated after each twenty seconds of exposure and incubated for twenty-four hours.

There was no significant difference in the number of bacteria colonies after the first twenty seconds of treatment. There was a significant amount of destruction of all three species of bacteria after the second and third twenty seconds of exposure in the microwave oven.

The length of exposure and temperatures reached were not enough to cause destruction of the bacteria by thermal means only. This study indicates that a non-thermal cause is an important factor in the death of the selected bacteria.

MAYONNAISE: FOOD SPOILAGE CULPRIT?

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The objective of this project was twofold. The first was to determine if mayonnaise has inhibitory effects on the growth of *Escherichia coli*. The second was to determine if these effects were exerted on total bacterial population density in a chicken/mayonnaise salad.

In the first phase of the investigation, two 70% sterile mayonnaise culture samples were aseptically prepared: one had a pH 4.0 and the other was set at pH 7.0 by titration with 1N NaOH. A standard inoculum was aseptically introduced into each of the samples. Every 12 hours, 1 ml aliquots were diluted in a tenfold dilution scheme, aseptically plated onto T.S.B. agar, and incubated for 24 hours at 30° C. Colonies of viable bacteria were counted.

In the second phase, the same procedure was repeated with two chicken salads smeared on T.S.B. and E.M.B. agar for assay of viable bacteria. Comparisons were made and results were tabulated in graphs, charts, tables and photographs.

The conclusion gathered after careful analysis is that sterile mayonnaise inoculated with *E. coli* exhibited inhibitory effects on microbial population density. Mayonnaise actually provided significant protection against the growth of foodborne bacteria due to its acidic content. When mayonnaise was added to the chicken, the pH of the mixture was much higher than that of the mayonnaise itself, and the mixture became a suitable medium for bacterial growth.

#THE ROLE OF THE LEADER REGION OF ISO-1-CYTOCHROME C mRNA OF SACCHAROMYCES CEREVISIAE IN THE PROCESS OF INITIATION OF TRANSLATION

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904 Valley Road, Terre Haute, In 47803

The purpose of this project was to clone and sequence the revertant CYC1+ gene of Saccharomyces cerevisiae and determine the role of the leader region in the process of initiation of translation of iso-1-cytochrome c mRNA.

In the yeast cyc 1-362 mutant gene, two point mutations have occured: an adenine to a guanine and a guanine to an adenine at the -18 and -30 positions, respectively. The former produces an initiation codon at the -18 position and causes the rest of the gene to be read out of phase, thus causing a 95% reduction in the amount of iso-1-cytochrome c synthesized. The revertant of the cyc 1-362 was the CYC1-362 gene.

Five strains of S. cerevisiae with the revertant gene in their genomes were transformed with two different plasmid: pAB30 and pAY7. The plasmids, which picked up the CYC1-362 gene, were isolated from transformants by cutting the chromosomal DNA with restriction endonucleases, ligating, and transforming into Escherichia coli. The plasmids were isolated from transformed E. coli, cut with the appropriate restriction enzymes, and the proper fragment was sequenced.

One strain transformed with pAB30 showed a sequence which was identical to that of the wild type gene in their leader regions. This indicates that the role of the leader region in the CYC1-362 revertant gene is that of a noncoding region as in the wild type gene.

#Fourth Award - General Motors ISEF

MICROBIOLOGICAL AND STATISTIC STUDY OF THE EFFECS OF DIFFERENT SALINE CONCENTRATIONS ON GROWTH OF STAPHYLOCOCCI: AUREUS AND EPIDERMIDIS

Burgos, Awilda I. - Luis Lloréns Torres Senior High School,
Juana Díaz, P.R. 00665
13, A Street, Río Cañas Abajo, Juana Díaz, P.R. 00665

This study represents an attempt to investigate the effects of different salines concentrations on the growth of bacteria, such as Staphylococci: aureus and epidermidis and to elucite the mechanisous underlining such an action.

Bacteria obtained from source in a hospital laboratory were first classified as pathogenic and non-pathogenic. Culture media were prepared in order to innoculate then with selected bacteria for further incubation.

Solution of Manitol Agar at different concentrations were prepared for the investigation. Both cocci were planted in dishes with different concentrations.

Simple vision observation of bacteria growth were made at first and recorded.

For microscopical observations bacteria were transfered to slides and using the tinction procedure further data about their growth or inhibition of it were recorded.

Staphylococcus aureus was found to be inhibited in its growth up to a concentration of 25%.

As a result of this investigation I may state that NaCl concentrations have inhibitory effects upon baterial growth, specially those two selected by me; and that new knowledge in an often overlooked field has been gained.

ISOLATION AND EVALUATION OF CELLULOSE DEGRADING MICROORGANISMS.

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The objective of this research was to isolate cellulose degrading microorganisms from compost or dung and select one with a(n) enzyme(s) that will yield useful simple carbohydrates in sufficient quantities to be a practical means for increasing our carbohydrate supply. The microorganisms were isolated from 10 different types of compost and dung by placing small bits of compost on strips of filter paper in liquid minimal medium. Sixty one of 200 tubes showed apparent growth on the filter paper. These 61 were tested further for utilization of cellobiose (a cellulose derivative). Eleven cleared the cellobiose in the plates. These were grown on powdered cellulose in liquid minimal medium for 10 days and the contents evaluated for the types of carbohydrates produced and the amount of starch broken down. This test is in progress now. An attempt will be made to isolate enzyme(s) in cell-free solution for use in producing the desired carbohydrate end products.

THE DEVELOPMENT OF CEPHALOTHIN RESISTANT STRAINS OF BACILLUS SUBTILIS AND ESCHERICHIA COLI

Lilavat, Narisa, T. C. Williams H. S., Alexandria, VA 22302
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A current problem in biology is the development of resistance to antibiotics by bacteria. *Escherichia coli* and *Bacillus subtilis* were tested to see whether these particular strains of bacteria would develop resistance to the antibiotic cephalothin. The first trial run indicated a lethal concentration for both *E. coli* and *B. subtilis* was 0.0592 mg/ml of agar. After four runs, the lethal concentration for *E. coli* had increased to 0.088 mg/ml and for *B. subtilis* was $0.065\overline{1}$ mg/ml of agar. Therefore both *Escherichia coli* and *Bacillus subtilis* have developed increasing resistance to the antibiotic cephalothin.

ANTIBIOSIS

Bui, Loc V., Biloxi H.S., Biloxi, Ms. 39530;
509 Oak St., Biloxi, Ms. 39530.

Study the effect of antibiotics on a black mold, Rhizopus Nigrican, inside a control environment, a vacuum incubator. Measure the rate the antibiotics inhibit the mold with a homemade photometer.

1. Build a vacuum incubator
2. Grow, transfer, identify, & isolate mold
3. Test 6 different antibiotics in 3 concentrations against mold
4. Build a photometer
5. The rates antibiotics inhibit mold were measure

Out of the 6 antibiotics Rimactane was the most effective antibiotic against Rhizopus Nigrican.

In conclusion, the result obtain from the experiments can be said to be quite accurate because the experiments were done in a control environment without any undesire variables affecting the experiments.

THE EFFECTS OF VARYING DOSES OF RADIATION ON SELECTED BACTERIA SPECIES

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The purpose of this research project was to determine if varying amounts of radiation has a deterimental or lethal effect on selected bacteria species. The bacteria species used in this research project were Rhizobium leguminosarum, Rhizobium japonicum, Bacillus cereus, Pseudomonas syringae. The bacteria were inoculated on nutrient or manitol agar, depending on the type of bacteria. After growth was established in the petri dishes, the bacteria were exposed to gamma radiation in three different amounts: 5,000 rads, 10,000 rads and 15,000 rads. A cobalt teletherapy machine was the source of the gamma radiation. The petri dishes were placed 60 centimeters from the radiation source. There was also a control for each species that was rated a ten or maximal growth, to which the other species were compared. Growth was observed after five and ten days.

In conclusion, the results indicate that radiation appeared to have a beneficial effect on the physical appearance of Rhizobium leguminosarum, Rhizobium japonicum, and Pseudomonas syringae, and a detrimental effect of Bacillus cereus. This is only the initial step for this research project, and through further investigation, more detailed conclusions can be ascertained.

#THE AMOEBA'S NUCLEUS: ITS CONTROL OVER AMOEBOID MOVEMENT

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This project attempts to establish a feasible theory concerning the nucleus' role in influencing the normal movement of Amoeba proteus. This theory evolved from my past and present work and that of others (Clark, 1942, 1943, 1944; Szent-Gyorgyi, 1947; and Lorch, 1969). In my experiments nucleate (+N) and anucleate (-N) amoebae were exposed to distilled water, .05M $MgCl_2$, and .1M $MgCl_2$. Last year distilled water, .05M NaCl, and .1M NaCl were used. The -N fragments were obtained through bisecting normal amoebae with a fine glass thread. The amoeba-halves were transported by micropipette to the five solutions used. The amoebae were observed for one hour. Their movement and activity were recorded every minute. Analysis of the two years' data showed that -N amoebae locomote and stream much slower than their +N counterparts in all five media. Also, an increase in the salinity of the media slowed both +N and -N halves. The main contrast shown between the use of $MgCl_2$ and NaCl was an increase in vicosity of amoebae in $MgCl_2$ and a decrease in viscosity in NaCl. My proposed theory states that messenger RNA is a template for the production of myosin, a muscle component and the ATPase in amoebae. Every two hours after mitosis, myosin becomes ineffectual. During those times, mRNA is sent into the cytoplasm to produce more myosin. Thus, contraction in the posterior of amoebae can continuously occur through energy from ATP use, and cell motility is assured.

#First Award - General Motors ISEF

STUDY OF BASIDIOMYCETES EXTRACTS FOR THE CONTROL OF PATHOGENIC MICROORGANISMS IN AGRICULTURE

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The most common fungi in Puerto Rico belongs to filum Basidiomycetes and apparently has not been of any particular importance for science; investigation has been very limited. We examined and reviewed written materials about this fungi to learn about its properties. Our main question has been if it has antibiotic properties capable of act against pathogenic microorganisms that plague agriculture.

The first three stages of the investigation were successfully accomplished. In the first one we used extracts of fungi Basidiomycetes in different solutions(100% distilled water and ethylic alcohol at 20% and 70%), as antibiotics for in-vitro tests. The second consisted mainly of a comparative research between different solutions prepared in the first stage that demonstrated to have antibiotic potential; to determine which ones could be used effectively in the next stage. In the third (in-vivo) we inoculated Tycopersicum Sp.and tomatoes with bacteria and antibiotics to observe inhibition zones and any other secondary effect of the same antibiotics over the vital functions of the plants and tomatoes.

In-vitro tests showed that fungi Basidiomycetes have sufficient antibiotic potential for the control of bacteria Xanthomona Versicatoria.In-vivo tests confirmed that the antibiotics used do not have negative effect on the plants or tomatoes. We observed that the antibiotics retarded the infection and one of them avoided spreading of the infection.

After having confirmed the antibiotic potential we will proceed with the identification and isolation of the antibiotic proteins to obtain a pure antibiotic. We will also experiment with different techniques to find the most effective one for the application of the antibiotic.

#IN VITRO INHIBITION OF DENGUE VIRUS REPLICATION BY DIDEMNIN B

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Bo. Cañaboncito-Box 216-K, Caguas, Puerto Rico 00625

Since dengue viruses are a major health problem in the tropical areas of the world, several laboratories are testing experimental vaccines as well as antiviral drugs to control this desease. The present study reports the effect of didemnin B on the "in vitro" replication of dengue viruses. Monolayers of LLC-MK$_2$ (monkey kidney cells) were infected with 0.2ml(about 100pfu) of either DEN-1 (Jamaica); DEN-2 (PR1129); DEN-3 (PR38) or DEN-4 (H241) viruses. The infected cultures were incubated for 5 days at 37°C with an agar overlay medium containing different concentrations of didemnin B (ranging from 0.5ng/ml to 7.8ng/ml). Cells were stained with neutral red and plaques were counted. Fifty percent inhibition of plaque formation was observed at concentrations of didemnin B ranging from 1.4ng/ml to 3.6ng/ml. No cytopathic effect was observed at drug concentrations equal to or less than 7.8ng/ml. It is concluded that didemnin B significantly inhibited the "in vitro" replication of dengue viruses at concentrations that did not produce cellular toxicity.

#Third Award - General Motors ISEF

GENETIC TRANSFORMATION OF *BACILLUS SUBTILIS* 168 *TRYPTOPHAN-*

by Tami Hall
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Traits can be transferred from one strain of bacteria to another through transformation. This method was used to transform a bacteria that lacked the ability to synthesize its own tryptophan.

Deoxyribonucleic acid was isolated from *Bacillus subtilis* W-23. This was accomplished by using a method derived from the Marmur procedure. This extracted DNA was stored in BPES buffer.

The cells were treated from an overnight slant of *Bacillus subtilis* 168 *try-* so that it attained a high level of competence. After this, the cells were cultured in contact with the DNA of *Bacillus subtilis* W-23 so that transofrmation could occur. These were plated on a selective medium lacking tryptophan so that the new hybrid cells would appear.

The buffer, the cells, and the DNA were plated in other combinations to assure that it was the cells plus the DNA that caused the growth of the hybrid cells. *Bacillus subtilis* 168 *try-* that had not come in contact with the DNA was also plated to make sure no cell growth would occur without transformation.

THE EFFECTIVENESS OF DISINFECTANTS

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11 Kanofski St., West Chermside, Queensland, Australia 4032

Five disinfectants at five dilutions were tested against three micro-organisms for intervals of five, ten and fifteen minutes. The standard pH and temperature was 7 and 25°C respectively. Later experiments using only one bacterial culture were carried out involving hot (40°C), cold (10°C), acid (pH6) and alkaline(pH8) conditions. All temperatures and pH values tested were suitable for growth of each of the three cultures.

Results showed that all disinfectants were effective if manufacturer's recommendations were followed. Effectiveness of each disinfectant varied as they were further diluted. The best disinfectant was still effective when diluted to one tenth of the recommended dilution given by the manufacturer. Most effects were evident after 5 minutes contact time, with slight improvement after 10 or 15 minutes exposure.

One disinfectant was affected by hot temperature, another by cold temperature. None were affected by pH8. but three were reduced in effectiveness by pH6. The yeast culture was the most sensitive of those tested regardless of the disinfectant used. Few differences existed between the two bacterial cultures.

#ISOLATION OF A VIRUS MUTANT DETECTIVE IN THE CONTROL OF CELL LYSIS

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2604 Caversham Cove, Memphis, TN 38119.

No abstract received.

#Fourth Award - General Motors ISEF

THE SYNERGISTIC EFFECT OF CARIOGENIC BACTERIA, *STREPTOCOCCUS MUTANS* AND *LACTOBACILLUS ACIDOPHILUS*

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Colonies of *Streptococcus mutans*, *Streptococcus salivarius*, and *Escherichia coli* were inoculated with a drop of 24 hr. *L. acidophilus* skim milk culture. After 24 hours incubation on tryptic soy agar, each colony was dissolved in 10 ml of sterile distilled water and counted in a 6 plate dilution series on anaerobic agar. A control of the *L. acidophilus* culture was also plated on TSA and counted by dilution. *L. acidophilus* grew significantly faster with *S. mutans* and *S. salivarius* than by itself, or with *E. coli*. A possible synergistic effect of *L. acidophilus* with *S. mutans* and *S. salivarius* was indicated. Possible procedural problems that could effect the results were discussed.

THE EFFECT OF ANTIBIOTICS ON BACTERIA

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General Delivery, Grimsley, TN 38565

The purpose of my project is to determine the effect of different antibiotics on certain types of bacteria. I obtained bacteria from four area hospitals which had been cultured from patients and identified as to species. Then I obtained bacteria from a commercial laboratory of the same species as that cultured from the patients. Using then 0.5 Macfarlind Standard I standardized all cultures obtained from the hospital and commercial laboratories.

I then conducted test using the plates of blood agar; chocolate agar; and Mueller Hinton agar. I streaked plates for each test with various types of bacteria using aseptic techniques, and placed commercially prepared antibiotic disks on each bacteria being tested. I incubated the plates for 24 hours and measured the zone of inhibition for each disk.

I found that there was a definite difference in the effect that some antibiotics had on the different types of bacteria grown in labortories and that obtained from patients.

#PROTEOLYTIC ACTIVITY OF *PSEUDOMONAS AERUGINOSA*

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Sixty-nine clinical and twenty-two hospital and environmental isolates of *Pseudomonas aeruginosa* were tested for their protease production using Sokol media, composed of Blood Heart Infusion Broth and Powdered Skim Milk. Clearing zones around colonies, signifying proteolysis, were measured at 48 hours. The purpose was to determine if any particular site is characterized by a certain protease production level and if this level is related to the pathogenicity of the organism. The clinical and hospital isolates were found to produce substantially more protease than those obtained from the natural environment. This relates well with the increased findings of nosocomial infections due to *P. aeruginosa* and the rare infection from the environment. This leads to the conclusion that protease production is a factor determining the pathogenicity of this organism. Those isolates obtained from the blood more actively produced protease than those obtained from other clinical sites. Urine and hospital isolates produced protease at similar levels to each other as did isolates from sputum and wounds.

#Fourth Award - General Motors ISEF

PRODUCTION OF BETA-LACTAMASE USING PENICILLIN G ON STREPTOCOCCI

Hugelen, Christine Marie, Maddock H.S., Maddock, N.D. 58348
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In my project, I test pathogenic *Streptococcus pyogenes* or *Streptococcus Group A* and *Streptococcus pneumoniae* bacteria for the production of Beta-lactamase (penicillinase) and for sensitivity to penicillin G. I used *Staphylococcus aureus* as my positive and negative controls. I obtained, grew, and identified my own cultures of these strains. Penicillin G used to be the choice prescription for a upper respiratory or throat infection. *S. pneumoniae* and *S. pyogenes* have always been sensitive to penicillin G until lately when strains of *S. pneumoniae* have been found to be producers of an enzyme called Beta-lactamase. *S. pyogenes* is being watched because it is a likely producer of this enzyme also. Beta-lactamase inhibits penicillin G. It catalyzes penicillin G into penicilloic acid. Therefore these strains are penicillin resistant. Beta-lactamase production almost always occurs when penicillin G is prescribed to *S. aureus* infections. It is never prescribed unless a sensitivity test or Beta-lactamase test is done first. The basic penicillin molecule has been modified so as to obtain Beta-lactamase resistant antibiotics. I isolated 4 strains of *S. pyogenes* and 5 strains of *S. pneumoniae*. I found only 1 strain of the *S. pneumoniae* to be resistant to penicillin G and Beta-lactamase positive. Penicillin G has been definitely overused so it is no wonder that different strains are forming resistance to it in order to survive. From my results, I concluded that either a sensitivity test or Beta-lactamase test should be done on *S. pneumoniae* when using penicillin G to assure its effectiveness, and a careful watch should be kept on strains of *S. pyogenes* when using penicillin G as an antibiotic.

#DEVELOPMENT AND ANALYSIS OF A PROTOTYPICAL VACCINE TO IMMUNIZE AGAINST INFECTION BY HERPESVIRUS-1 (HSV-1)

Thrailkill, Timothy A., Melbourne H.S., Melbourne, FL 32901;
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This study has attempted to develop an attenuate vaccine for prophylaxis of HSV-1 disease. The pathogenesis of this virus ranges from herpes labialis to herpetic encephalitis and its related nervous sequelae, the second foremost cause of viral mortality. Additionally, the etiology of herpes-biased infection (in terms of recurrency) has rendered antiviral chemotherapy and non-live vaccines incompletely effective.

Attenuated strains of HSV-1 were developed by exposure to MNNG (100ug) MMS(96ug), UV radiation (468J), Co-60 radiation (155kr), and five anti-variants were extensively tested *in vitro*, *in vivo*, and *in situ* for virulency reduction. Monospectral assays were developed to spectrophotomically analyze cytrovirulency in cell suspensions. Immunodiffusion tests were performed to identify antigenic similarity between wild-type and mutagenized strains. Antibody microtitration and viral neutralization tests were conducted to assure identical immunologic response *in vivo*. The gD monoclonal antibody was employed in microassays of *in vitro* neutralization and plaque-inhibition. Finally, both passive (human -globulin) and active immunization tests were performed in susceptible mice.

To conduct experimentation *in vitro*, a special non-current chamber was constructed and approved prior to release of the viral samples. Thus all work was conducted by the student. Later experimentation was done in an animal research lab and under a grade 2 laminar hood.

After statistical analyses (^{2} and t-test), it has been concluded that after each new strain has immunization potential. Current research on reactivation assays and future research, already contracted for, on human subjects will explore the applicability of the results found.

#First Award - United States Air Force
First Award - United States Army
Second Award - American Society for Microbiology
Third Award - General Motors ISEF
Merit Award - American Medical Association

#THE ANTIBIOTIC SUSCEPTIBILITY OF BETA-LACTAMASE PRODUCING *BACTEROIDES MELANINOGENICUS*

Bahn, Bruce R., Horton Watkins H.S., St. Louis, MO 63124;
1121 Beau Jardin Ct., St. Louis MO 63141.

Various strains of *Bacteroides melaninogenicus* produce beta-lactamase, an enzyme that destroys certain antibiotics. This causes a clinical therapeutic problem because the antibiotics used to treat *Bacteroides* infections become ineffective. The purpose of this study was to determine the concentrations of various antibiotics which are most effective in treating *Bacteroides* infections. Clinical samples were cultivated on LKV blood agar plates and incubated anaerobically. The *Bacteroides melaninogenicus* colonies were then identified and isolated. Beta-lactamase testing was done in order to determine the frequency of Beta-lactamase production. Minimal Inhibitory Concentration (MIC) tests were performed on the isolated strains agaianst a variety of antibiotics. Those antibiotics showing the lowest MIC will be recommended for clinical therapy.

#Fourth Award - General Motors ISEF
Honorable Mention - United States Air Force

TERTIARY OIL RECOVERY USING MICROBIAL BY-PRODUCTS

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The purpose of this project is to demonstrate tertiary oil recovery using surfactants produced by microorganisms grown on hydrocarbon. A culture of hydrocarbon oxidizing bacteria was by enrichment in a mineral salts medium containing the linear alkane, n-tetradecane, this was followed by isolation on solidified growth media. Surfactants produced as a result of bacterial growth on hydrocarbon substrate were passed through a column containing a mixture of sand and hydrocarbon. The process was determined by gas chromatography and compared to quantities extracted with laundry detergent and distilled water. The data indicated that the bacterial culture recovered twelve times more hydrocarbon than did the detergent, while the distilled water extracted none. In conclusion, tertiary oil recovery using microbial by-products is a viable alternative to the use of man-made chemicals for this purpose.

THE EFFECTS OF CALCIUM AND MAGNESIUM ON THE ATTACHMENT OF THE T^4 PHAGE TO *ESCHERICHIA COLI*

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The purpose of this research was to first test the effect of varying concentrations of Ca and Mg ions on the ability of the T^4 phage to lyse *E. coli*, and secondly to determine if Ca or Mg concentrations affect the ability of the phage to attach to the *E. coli*. The first part was performed by growing the virus in aerated broth and plating the virus suspension along with *E. coli*. Plaque counts gave a measure of the lysis rate. The second part was performed by labeling the proteins of the phage with ^{35}S and allowing the phage to attach to the *E. coli* in varying Ca and Mg concentrations. Binding of the phage was determined by counting washed, pelleted *E. coli* cells with a Geiger-Muleller counter. The results seem to indicate that Mg had an inhibitory effect apparently hindering phage attachment. The results also indicate that Ca stimulates attachment at an optimum concentration of 150 ppm; with higher concentrations Ca seems to hinder the attachment of the phage.

ZOOLOGY

#GILL-SPINE SENSITIVITY TO CO_2 IN *LIMULUS POLYPHEMUS*

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35-04 153rd St., Flushing, N.Y. 11354

The gills of the horseshoe crab, *Limulus polyphemus*, contain spinelike chemoreceptors. The specific chemical to which the gill-spines are sensitive and their regulatory effect on the organism were not known before this study.

The first objective was to localize the specific stimulus. A Y-shaped maze was constructed and filled with seawater to allow an adult crab to move from the base of the Y to the middle where it could make a choice between left and right arms to indicate attraction or aversion to selected chemicals. Fresh water, O_2, and CO_2 were entered in one arm and the crabs' reaction to them measured.The trials were repeated with the same chemicals but with the crabs' spines surgically removed. The experiments have proven that the gill-spine receptors of *Limulus* are able to detect CO_2 concentration changes.

The next objective was to determine how the spines, when stimulated by an increase in CO_2 concentration, affect *Limulus*. A respiration tank in which the CO_2 content of the water could be altered was constructed. Crabs were placed in the chamber, their gills connected by a thread to a kymographic recorder. Carbon dioxide concentration was increased until the animal reached systolic arrest with spine intact and spine removed. The gill-spines, when stimulated by an increase in CO_2 concentration, elicit a neural inhibition of the ventilatory reflexes, causing immediate disruption of breathing and the rapid onset of apnea.

#First Award - Marine Technology Society
Second Award - General Motors ISEF

EFFECTS OF ACETIL SALICILIC ACID IN THE DEVELOPMENT AND GROWTH OF MELANOTIC TUMORS IN DROSOPHILA MELANOGASTER

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Santa Isabel PR 00757
Box 1033 - San ta Isabel, PR 00757

Many genetic principles of those studie with Drosophila are applied to an extent number of diploid organisms. That's why the flies are being considered ideal to demostrate and study those genetic principles. For this reason, I used the ML^{ts} with tumors and the Oregon R as control. To try to control the growth of melanotics tumors, I applied 0.1% acetilsalicilic acid to the culture of the flies. This experiment was realized at a temperature of 29°C because at this temperature the melanotic tumors appeared more frequently in the ML^{ts} To begin this experiment, ten larvas were placed inside the flasks. They were observed daily until they reached the adult stage or until the first generation. In this lapse of generations we observed that the color of the tumors was turning lighter as they passed from one generation to another, until the point in which the tumors were harly observed or any signed of the tumors could be seen. Due to this results. I can generalize that the acetilsalicilic accid at 0.1% is a possible control for melanotic tumors in the ML^{ts} .

THE EVOLUTION OF AERODYNAMICS IN MODERN INSECTS

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Of all the flying organisms that have roamed the earth, the insects are by far the oldest and most successful. Sixteen of the twenty insect orders have species capable of flight, some with speeds in excess of one hundred miles per hour and ranges of as far as one hundred fifty miles. Their flight mechanisms have evolved to a point so near perfection that they have remained the same for thousands of years. For this reason and because these mechanisms are phylogenetic, there is an interesting possibility to question the comparative evolution of insect aerodynamics. This study involves a comparative evaluation of insect aerodynamics through wind tunnel testing.

A vertical stream wind tunnel was used to obtain drag readings at seven angles of attack for each of the sixty-four specimens studied. These finalized readings were then correlated and graphed to obtain my final results, which follow in brief:

1)Wing loading, the ratio of weight over wing area, has generally increased in the modern orders of insects, as compared with the ancient orders.
2)Maximum speeds have gradually reduced in the modern orders.
3)Frontal drag shows a decrease in the modern orders.
4)Glide ratios seem to be increasing.
5)Finally, drag at the optimum angle of attack has shown a definite decrease in the modern orders.

Cryobiology

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The purpose of my experiment is to find the eutectic points of hematocytes and pencillin mold yeilding the highest survival success percentage. My experiment, shortened for this summary, would go like this

Part 1: Hematocytes are centrifuged out of whole blood. Then a cryoprotectant of glycerol was introduced and frozen to a temperature of 176° C. Thawing was accomplished by a vibrating warm-water bath and detoxification by a gamut of washes with saline solution of decreasing concentration.

Part 2: Penicillan mold was grown in yogurt and agar cultures and frozen by butane and dichlorodiflouromethane with cryoprotectant of glycerol. Thawing was accomplished through air gradually being heated and ditoxification again by washes of saline solutions of decreasing concentration.

In doing my preliminary experiment with blood I found that when blood is frozen its composition is 100% hematocytes. If these leukocytes which were removed were frozen then exposed to an antigen in a lab, a controlled environment, and reintroduced into living organism (perhaps man) this could be a preventative panacea for all illnesses.

The idea led me to the second part of the experiment where pencillan mold was frozen; the reason for this being, that if the pencillan mold could be successfully frozen and bought to a functional state then so could other forms of molds and bacteria, thus proving the idea for a universal panacea.

INTRACELLULAR AND EXTRACELLULAR MICROORGANISMS: ISOLATION, CHARACTERIZATION, AND ELIMINATION IN PERIPLANETA AMERICANA

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73 High Ridge Road, Trumbull, Conn. 06611

Many insects harbor intracellular and extracellular microorganisms that fill gaps in the insects' nutritional needs. Bacterial microorganisms of certain insects can possibly be eliminated or adversely affected by the induction of antimicrobial drugs. This in turn may affect the host insect in an adverse manner. Should these two assumptions prove valid, this process could offer new possibilities in safe and effective insect control.

To substantiate these assumptions, an insect, *Periplaneta americana,* was chosen for study. Material from intracellular and extracellular regions was removed from selected specimens, and examined for microorganisms through cultural technique and direct observation. Four types of bacterial growth were isolated from the intestinal tract and surrounding mesentary; intracellular bacteroids were isolated from the fat bodies, and protozoan-like objects observed in several areas. Enumeration and differentiation techniques were performed on all isolated microorganisms to provide approximate classification. Antibiotic assays were then carried out on isolated bacteria, and effective antibiotics were added, in serum form, to prepare insect diet. Effects on selected insects were then observed.

Bacterial elimination was observed in tested insects, even at low antibiotic concentrations. These results substantiate the first of the two original assumptions. However, no apparent effects were observed on the host insect used in this study. If host insects can be found which are critically dependent on specific bacterial microorganisms, thereby validating the second assumption, this technique offers a new approach for insect control.

THE EFFECT OF DIMETHYL SULFOXIDE ON THE PHAGOCYTOSIS OF AMOEBA PROTEUS

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1108 Greenwood Ave., Wyncote, PA 19095

There is a current controversy over the effectiveness of dimethyl sulfoxide in the treatment of edema. Leukocytes tend to migrate toward areas of swelling, as in arthritis, and like amoeba consume food by means of phagocytosis. Since leukocytes are difficult to handle, *Amoeba proteus* was chosen as the specimen to be tested.

The process of phagocytosis was measured by counting the number of food vacuoles in the amoebae. The specimens were compared visually in terms of locomotion, physical characteristics, and responsiveness (irritability). The amoebae were exposed to concentrations of dimethyl sulfoxide varying from 2.5% solution to 50% solution.

It was found that the amoebae exposed to between 2.5% and 10% dimethyl sulfoxide solution showed no significant change in the number of food vacuoles present. Amoebae exposed to between 12.5% and 22.5% solution demonstrated a marked decrease in the number of food vacuoles as well as structural changes in the nuclear membrane and decreased function of the contractile vacuole. Solutions of 25% or greater concentrations were toxic to the specimens.

It can be concluded that there is a direct relationship between the concentration of dimethyl sulfoxide in solution and the rate of phagocytosis in *Amoeba proteus*: the higher the concentration of dimethyl sulfoxide, the more pronounced the effects are on the amoebae. It can be inferred that if these results are reproduced using leukocytes that dimethyl sulfoxide may be shown to be an effective treatment for arthritis.

#DETERMINING BIRD SURVIVAL RATES AND AGES

Goodin, John T., Thomas S. Wootton H.S., Rockville, MD 20850;
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By attaching small, metallic bands to the legs of birds, man has been able to discover some of the long-kept secrets about bird life. Bird-banding has yielded facts on the behavior of birds, their populations, and their migrational patterns in addition to other valuable information. One aspect of bird-banding programs involves "returns" - those birds previously banded that are caught again at the same location during a subsequent season.

The purpose of my research was to determine the annual survival rates and maximum ages of six bird species using the "return" data from the bird-banding station at which I work. By graphing these records and charting the rates, I calculated my results.

I found that most of the bird species had annual survival rates of approximately 55%. Two species, the Red-Eyed Vireo and the Carolina Wren, had significantly different rates of 77% and 27% respectively. After noting the age distributions of the six species, I discovered that the Red-Eyed Vireo was composed almost exclusively of returns banded as adults, and the Carolina Wren was composed primarily of returns banded as immatures (pre-adults). The other four species had a more even distribution between adults and immatures.

My three most important conclusions regarding this project were: (1) annual survival rates of these six species approximated 55%; (2) survival rates are higher among adult birds than immature birds; and (3) by comparing my computed maximum ages with officially recorded maximum ages, the annual survival rates are an accurate means for computing maximum ages of these species.

#Third Award - General Motors ISEF

#THE GEKKONID GENUS NEPHRURUS IN SOUTH AUSTRALIA AND NORTHERN TERRITORY WITH OBSERVATIONS ON THE BIOLOGY OF A NEW SPECIES FROM SOUTH AUSTRALIA.

Delean, Steven C., Seacombe High School, Adelaide,
South Australia, 5049.
49 Davenport St., Seaview Downs, South Australia, 5049.

Morphological and biological characters of the five species of Knob-tailed Gecko known to inhabit South Australia and the Northern Territory of Australia - *Nephrurus asper* Gunther, *Nephrurus laevissimus* Mertens, *Nephrurus levis* De Vis, *Nephrurus stellatus* Storr and *Nephrurus sp. nov.* Harvey - are described.

The data shows that the overlap in many of the scalation characters is considerably more than has been reported by previous workers, and that dorsal coloration is still the most reliable diagnostic character.

Aspects of the biology of *Nephrurus sp. nov.* are described in the second half of the paper. Data collected on population size, sex ratios, reproduction, times of activity, relationships to environmental temperatures, predation, feeding and aggressive behaviour, is analyzed.

It has been discovered that *Nephrurus sp. nov.* is the rarest of all Knob-tailed Geckos and that further protection may be required to prevent its limited habitat being destroyed.

#First Award - Eastman Kodak Company
First Award - General Motors ISEF

#A STUDY OF THE FAMILY VERONICELLIDAE GRAY 1840 IN SOUTHWESTERN PUERTO RICO: ITS ECOLOGY, BEHAVIOR, ANATOMY AND HISTOLOGY, WITH EMPHASIS ON ITS NEUROSECRETORY CELLS.

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The slugs are gastropods found under stones and leaves in wet places and are widespread the tropics. In Puerto Rico five species were found: *Veronicella portoricensis*, *V. floridana*, *V. occidentalis*, *V. krausi* and *Vaginulus plebejus*. Descriptions of external and internal morphology were made with a key to identify them by pigmentation patterns. Thirteen stations were studied in Puerto Rico. Environmental parameters were measured finding these to be quite stable. The animal community was described. Several specimens (snails, earthworms, isopods, ants, and millipeds) live with these species in the habitat. *Angiostrongylus cantonensis* was not found in the species examined.

Aggregative behavior was studied in the laboratory. Eight aggregations were observed in a period of five minutes. A relation between time and aggregations was found ($y \doteq .007 \neq .01x$, $r \doteq .99$). Several places have reported the slugs caused damage to vegetable's plantations. Tests done in the laboratory showed the slugs ate in 24 hours 0.51g of tomato,.18g of green and red peppers. A relation between time and vegetable consuption was found. Several substances (metaldehyde, beer, calcium arsenate, wine and grape juice) can serve as attractants of these species. Four day tests in the habitat showed that Vigoro Slug Killer^{RM} was the most effective substance (74.3%), followed by beer (71.4%).

The central nervous system consists of paired cerebral, pleural, parietal, pedal and visceral ganglia fussed in a ring. The weight of the ganglia was 0.0039g and the ganglial index was 0.18%. Three cells were identified in the central nervous system: *Cell A* (61.5 x 42mu), *Cell B* (37.7 x 25.9mu) and *Cell C* (4.8 x 4.1mu). These cells gave positive reaction to CH and PF, indicating their possible neurosecretory property.

#Honorable Mention - Eastman Kodak Company

#REPELLENCE IN THE *LUMBRICUS TERRESTRIS*

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1143 Starmount Ct., Bel Air, MD 21014.

A box with 6 defined squares was used to determine if stimulated worms produced a substance that repelled other worms. Control and experimental runs were done by placing 3 worms in each square and recording positions after 2.5 minutes. Stimulated worms each received 15 volts and 0.5 milliamperes for 1 second twice. In 5 isolated control runs (90 worms), no squares were vacant. In a second test series, a control run was followed by placing 2 worms in a square, stimulating them, and removing them after 10 seconds. An experimental run followed immediately. In this series, in 10 control runs (180 worms) only once was a square vacant; in 6 of the 10 experimental runs, the square where worms were stimulated was empty. In a third test series, a preselected square was swabbed with clean cotton and a control run was done. The same square then was swabbed with cotton that had been used to wipe 2 stimulated worms, and an experimental run was done. In this series, in 10 control runs (180 worms) following only clean cotton swabbing, no squares were vacant. In the 10 experimental runs (following transfer of worm substance), the swabbed square was empty 7 times. These data support the hypothesis of stimulated worms producing a substance that repelled other worms.

#Fourth Award - General Motors ISEF
Honorable Mention - American Psychological Association

EXPLORATION OF FIVE CAVES IN SOUTHWESTERN PUERTO RICO WITH EMPHASIS ON SOME ASPECTS OF THE BIOLOGY OF THE PUERTORICAN "GUAVA", *TARANTULA PALMATA* C.L. Koch

Rivera, Leoncio, Lola R. de Tio H. S., San Germán, P. R. 00753;
Calle A Buzón 222, San Germán, P. R. 00753.

This investigation represents an attempt to begin the study of the puertorican "guava", *Tarantula palmata* (C.L. Koch), present in the limestone caves, located in the southwestern region of Puerto Rico. The caves in the southern part of the island have never been studied in any respect. One of its inhabitants, known also from caves in the northern part of the island, has received the same scant attention.

The specimens used in this investigation come from five caves, all located in different sections of the municipality of San Germán. The caves are inhabited by this arachnid among other forms of life. The caves were studied as to size and geological traits. Soil samples of each cave were also collected and analyzed for moisture content, soil particle size, water holding capacity, pH and mineral content. Ecological parameters such as wind velocity, relative humidity, soil and our temperature and light intensity were measured in each cave.

Several facts related to the biology of *Tarantula palmata* have been determined. The arachnid was found to consume .02376 cc/hr with a respiratory rythmn of 133.4 kg/hr. An average of ten amino acids were found of specimens from four caves. Analysis of their chemical composition showed they consist of 63.4% of water, 2.41% of organic matter and 34.1% of minerals. The arachnid was found to move at a velocity of 4.00n/s. Preference for light or darkness was determined as well as resistance under water. A morphological study was carried out to determined for the first time spermatogenesis and oogenesis in this arachnid.

SOME ASPECTS OF THE HEMATOLOGY, PARASITOLOGY AND MORPHOLOGY OF *HEMIDACTYLUS BROOKI HAITIANUS*: WITH NOTES ON THE GENUS *SPHAERODACTYLUS*

Martinez, Angel R. Blanca Malaret High School, Sabana Grande,P.R.00747;
Pedro de Acosta B#86, Sabana Grande, P. R. 00747.

Hemidactylus brooki Gray 1834 is the gecko (Squamata: Gekkota) with the widest distribution in Puerto Rico. Kluge (1969) and Rivero (1978) consider this gecko as a subespecies (*H. brooki haitianus*). This is a nocturnal lizard, but it has been observed hunting during the daytime. Observations on its morphology were done. This investigation reports four new localities for another gecko (*H. mabouia*) in Puerto Rico.

This investigation presents the first hematological study of this species. The morphology of its blood cells has been determined. The erythrocytes and platelets turned out to be the most abundant cells. In the series of the leucocytes, neutrophils, lymphocytes, eosinophils, basophils and monocytes followed in abundance in that order. For the identification of the blood cells, several stains were used: Wright's, Camco, Giemsa, Methylene blue and Janus Green. The best combination for the staining of cells was obtained. Hematological indexes such as hemoglobine, hematocrit, cell counts and differential white blood cells counts were determined. Some developmental states of the neutrophils were identified.

With regards to the parasitology of this species, ectoparasites as well as endoparasites were found. Ectoparasitic acari of the family Pterygosomidae (two different species from *H. brooki haitianus* and one from *Sphaerodactylus sp.*) were found on the skin of these geckos. The endoparasites include a new host report for *Raillietiella hemidactyli* Hett 1934 (a pentastomid) and for *Oxysomatium portoricensis* Rodriguez de Vega 1968. Other nematodes and a trematode were found.

#INVESTIGATION OF BACTERIAL SYMBIOSIS IN SARCOPHAGA BULLATA

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Some species of insects have developed a symbiotic relationship to bacteria. Many of these insects are actually dependent upon the symbiotic bacteria for survival. The prime objective of my project is to determine if the fleshfly Sarcophaga bullata has symbiotic bacteria.

Five isolates of endogenous bacteria were isolated from the adult fleshfly. Bacteria isolates identified included Proteus mirabilis , Pasteurella species, possibly Pseudomonas species, and at least two gram positive bacteria. The isolates were tested with a variety of antibiotics to determine which antibiotics were most effective in inhibiting growth. Chloromycetin was found to be most effective; while erythromycin was least effective. Fleshfly larvae were treated with both of these antibiotics and their weight was compared to untreated controls. Treated fleshfly adults were homogenized to determine if bacteria previously isolated in controls had been eliminated.

Treatment with chloromycetin caused a significant decrease in larval weight, but erythromycin treatment had little effect. Gram-negative bacteria previously isolated in controls were not found in treated flies. The fecundity of the flies, however, was not affected by the bacterial elimination. This data suggests that the bacteria eliminated from Sarcophaga bullata may serve some minor symbiotic functions in development, but was not vital to the survival or reproduction of the fly.

This process of bacterial elimination may prove to have a potential for insect control if applied to insects whose bacteria serve vital symbiotic functions.

#Fourth Award - General Motors ISEF

AN ECOLOGICAL STUDY OF THE MARINE GASTROPOD TECTARIUS MURICATUS (LINNE) WITH A COMPARATIVE STUDY OF ITS POPULATION ALONG THE ROCKY COAST OF PUERTO RICO

Torres, Wallace, Lola R. de Tio H.S., San Germán, P. R. 00753;
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Tectarius muricatus is a marine gastropod along the rocky coasts of Puerto Rico. This investigation attempts to compare the populations of this snail along seventeen stations around the Island of Puerto Rico. Populations were compared along density gradients, size, ecological and biochemical patterns.

Some biochemical tests were made in order to compare the species in every station used. The tests carried out included calcium content, aminoacids, protein content, photosynthetic pigments present and the value of fats. Percentages of water, organic matter and mineral were determined. All these biochemical components were found to vary among the populations of all stations.

The snails were found to geotaxically negative, tending to move up from the water level. They were found to be nocturnal in habit and quite resistant to dessication. Snails kept in the laboratory after two years are still alive. Populations of this snail show a clumped pattern of distribution. Density of populations vary according to the size of the same. Some populations showed 257 specimens per meter square while others could not be measured. They feed mainly on the alga Ectophysalis crustacea. The alga is responsible for the dark color and warm temperature of the rock.

Tectarius shares its habitat with Nodolittorina tuberculata and Littorina zic zac.

FLIGHT PATTERNS OF ANTICARSIA GEMMATALIS (HUBNER)

Novinger, Nina M., Wildwood High School, Wildwood, Fla. 32785
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The Velvetbean Caterpillar, Anticarsia Gemmatalis (Hubner) is a major destructive pest of soybeans in the southeastern United States. This insect is pesticide resistent in many cases unless the pesticide has been applied within seventy-two hours. This makes it difficult and expensive to control these insects. Therefore, a means of predicting the dispersion habits of these insects is needed.

This experiment was conducted at the Insect Population Control Center at the University of Florida using a flight mill designed by graduate student, Paul Wales. This flight mill measures number and duration of flights per hour.

It was projected that this experiment would obtain results similar to those in the 1976 flight studies by Norman C. Leppla. However, instead of obtaining a common flight pattern for the VBC, a variety of flight patterns were obtained. Thus, it was concluded that a common flight pattern did not exist among the individual insects.

Finally, the data was compiled and averaged producing a mean flight pattern for the insects. The preliminary results show that the mean flight patterns contain several similar characteristics. Thus it was concluded that the mean flight pattern of mated and virgin VBC are similar.

A BEHAVIORAL AND PARASITOLOGICAL STUDY OF QUISCALUS NIGER AND REPORT OF A HOST FOR NEPHOROSTOMUM DIETZ, 1909

Bonilla, Ana S., Inmaculate Conception Academy, Mayaguez, P. R. 00708;
Los Ingenieros 16 1-A, Mayaguez, P. R. 00708.

This investigation involves a behavioral and parasitic study of the bird Quiscalus niger brachipterus Cassin which is endemic to the Island of Puerto Rico and Vieques.

The behavioral study includes different aspects of the biology of these birds. Observations were carried out on some aspects of these organisms way of life such as: nesting, care of the brood, fowl community life, fowl vs fowl reactions under different situations, brood singing, habitats and daily activities. Special attention was paid to the structure of the Quiscalus nest. A structural study was also carried out. Its feeding habits were studied. An attempt was made to estimate the number of birds in each colony.

The parasitological study was divided into external and internal parasites. Adults as well as offsprings were examined. Most of the external parasites turned out to be acari. These come from both the birds and the nest. Parasites were preserved in alcohol and studied under the microscope. Internal parasites were found in some birds for a toal of 72 in 29 birds examined. Parasites found were mainly nematodes, an acanthocephalon and a trematode of the genus Nephrostomum Dietz 1909. This constitutes the first report for Nephrostomum from Quiscalus making this a new host record for Nephrostomum.

#A BEHAVIORAL STUDY OF THE SYMBIOTIC CRAB *CRYPTOCHIRUS CORALLICOLA* (VERRILL, 1908) AND ITS PREFERRED HOSTS IN SOUTHWESTERN PUERTO RICO

Torres, José A. Lola R. de Tio H.S., San Germán, P. R. 00753;
29 Luna St., San Germán, P. R. 00753.

Cryptochirus corallicola (Verrill, 1908) is a gall forming crab of corals, of the Family Hapalocarcinidae, that has been recorded from the Bermudas, the Straits of Florida, Dominica, West Africa and the Gulf of Guinea. The crab is found living among the polyps of the corals it inhabits. This investigation represents an attempt to determine the presence of the symbiont along the southwestern coast of Puerto Rico and its preferred hosts with a study of its behavior towards the corals. To carry out the study several stations, noted for the presence of corals, were selected. Environmental parameters were measured. Over 4,000 specimens of the crab have been collected with over 3,000 corals examined for the presence of the crab. *Isophyllia sinuosa*, *Diploria strigosa*, *D. clivosa*, *Montastrea annularis*, *Agaricia fragilis*, *A. teunifolia*, *A. lamarcki*, *A. agaricites*, *Manicina areolata*, and *Colpophyllia natans* were found to harbor the crab in puertorican waters. The galls were studied to compare the galls formed in each different host. The study involved some 6,000 behavioral tests, including reaction to light and darkness, host specificity, vision, angle of vision, color preference, olfaction, preference to right of left and locomotion tests.

The literature shows that the crab had been reported from the Pacific Ocean on the coral *Leptoria tenuis*. The study indicates the crab makes a round cave and fits itself among the breaks in the coral. This is not so in the Atlantic. The type of symbiosis was not determined. The crab is reported for the first time from puertorican waters reporting 10 new hosts for the crab and the symbiosis is considered a commensalistic one.

#Fourth Award - General Motors ISEF

#THE ADVANTAGES OF PRODUCING SWINE AND CATTLE HYBRIDS

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Carriere, MS. 39426

The purpose of this project is to give a complete explanation of the good and bad characteristics acquired from breeding and the immunization of internal parasites of swine.

Breeding of purebred boars to selected females resulted in a more sound carcass, less fatty meat, longer breeding span, and increased vigor. Three generations of breeding were completed with an overall average of larger litters. The second generation (F2) contained 8 live born piglets. The F3 contained 10 live born piglets, with only 5 surviving the F1 litter.

Many advantages are obtained which benefit not only the producer, but consumer as well. Parasitic immunity was bred into two generations of swine. One generation being free from parasites; the other infested with them. An overall 72% decrease in parasites was obtained from the breedings. Swine being treated for parasites by vaccination had only 16% less parasitic count as opposed to the 72% decrease in the swine having the characteristics bred into them.

A crossbred Black Angus cow was bred to a Hereford bull being executively dominant. The crossing of a Charlois bull to a Black Angus cow produced a 1/2 Charlois:1/2Black Angus progeny. A Black Angus cow crossed with a Hereford bull produced a white faced, black progeny. All of the progeny were very sound in overall appearance and muscling. Color patterns were all complete. Total average weight gain per pound of total digestive nutrients was maximum. The complete process of these breedings covered a three year period beginning in December 1976.

#First Award - American Veterinary Medical Association

#EXTERNAL CONTROL OF GENUS GASTROPHILUS WHILE IN EGG STAGE

Guffey, Andrea, North Ogden Jr. High, Ogden, Utah 84404
3179 No. 1000 West, Ogden, Utah 84404

The bot fly, Gastrophilus, is a bee-like insect which lays small yellow eggs on the chest and forelegs of horses. These eggs disturb the horse, causing it to like its hair. Thus, the eggs migrate onto the tongue of the host. The process of friction(licking), moisture, and heat help the larvae to hatch and migrate to the stomach. The larvae attach to the stomach wall and rob the host of valuable nutrients. If a large amount of bots infest in the host,they can cause malnutrition, colic, and even death. My project deals with trying to stop this problem before it starts. Its purpose is to try to find a substance which could possible stop, or slow down the progress of hatching of the Gastrophilus while the eggs are attached to the hair of the legs. Many chemicals may work, but another problem of this procedure is that the chemicals concluded upon must not harm the skin, hair, or be toxic to the horse. I hypothesize that a substance or a mixture of substances can effectively control the eggs without causing harm to the skin or hair. During my experimentation, I found that several chemicals inhibited the growth and hatching of the eggs, but some acturally enhanced the hatching. As for the toxicitity tests, I have found no chemicals that stopped the growth completely, (without the chemical being harmful) but I did find some substances that slowed the hatching of bots considerably.

#Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society

HERBICIDES: DO THEY AFFECT DROSOPHILA MELANOGASTER?

Frank, Diane E., St. Clair H.S., St. Clair, MN 56080
RTE 4, Box 111, Mankato, MN 56001

This project was done to find out the physical and genetic effects a controlled level of herbicide has on the wild type Drosophila Melanogaster.

To test this hypothesis, successive generations were exposed to 2,4-Dichlorophenoxyacetic-acid or Metolachlor, the most widely used broadleaf and grass control herbicides. Both a normal percentage and a 1% concentration were used. The 1% level was determined by decreasing a starting concentration of 1.5% until the highest percentage they could tolerate was reached. These mixtures were used for the moisture in the medium. All cultures were started with five male and five female flies from a common stock vial. The length of each stage, chromosome slides, pictures, daily observations and number of flies at the end of each generation were taken.

The fertility rate of flies exposed to herbicides was very irregular, many times drastically reduced yet sometimes increased. Many larva failed to develope into pupa. Many pupa formed on the medium instead of a dry surface. The total number of days taken to complete the life cycle was also increased.

In conclusion, I have found through my experiments that herbicides noticeably affect the Drosophilas' life cycle. I feel further research is needed to determine to what extent insects are being affected by herbicides to protect our environment.

#FIRST COMPLETE DESCRIPTION OF THE LIFE CYCLE OF THE SAWFLY *SERICOCERA KRUGII* (CRESSON, 1880) (HYMENOPTERA; TENTHREDINOIDEA; TENTHREDINIDAE): A PEST OF THE SEAGRAPE *COCCOLOBIS UVIFERA*

Pérez, Francisco, Colegio San José, San Germán, P.R. 00753;
Urb. Porta Coeli A--11, San Germán, P.R. 00753.

This investigation attempts to describe the life cycle of the sawfly *Sericocera krugii*. A revision of the literature showed that the life cycle of this species has not been fully described. This organism depends almost exclusively on a very important element of our beach ecosystem, the seagrape, *Coccolobis uvifera*. The larva feeds on leaves of this plant causing extensive damage to the plant. This, together with the fact that its life cycle is not known gave me the stimulus to carry out this investigation.

The coast of Puerto Rico was examined for the presence of *C. uvifera*. Positive stations were established wherever the presence of the sawfly was detected. Environmental parameters were measured at each station. Fifty leaves containing egg clutches were collected whenever possible. Larvas, pupas and adults were also collected.

Measurements for the eggs, average number of eggs per clutch (26) and of clutches per leaf (2) were determined. Three oviposition patterns were found. Changes in color, and percentage of hatching of eggs were also determined. Six larval instars have been found. Average measurements for male and female pupae were obtained. Time pupal period takes, changes inside pupae were determined. Percentage of mortality or diapause during this phase (20.5%) was determined. It was found that the sex of an adult in a pupa can be predicted according to size. No pheromonal activity has been found, and two natural enemies for the sawfly has been found: the larvas of *Selenothrips rubrocinctus* and *Crysopha*.

#Second Award - Entomological Society of America

#EFFECT OF COLD STRESS ON THE RESPONSE OF ADRENAL AND MALE REPRODUCTIVE TISSUE TO TESTOSTERONE

Hudmon, Andy, Auburn H.S., Auburn, AL 36830;
264 Oak St., Auburn, AL 36830

The effect of cold stress on seminal vesicular response to graded levels of testosterone in young orchiectomized and intact rats was examined. Animals were housed for 20 consecutive days at either 25°C (control) or 4°C (cold stressed). Within each temperature group animals were subdivided as follows: sham orchiectomized - oil injected; orchiectomized - oil injected; orchiectomized - 0.1 mg testosterone per day; and orchiectomized - 1.0 mg testosterone per day. Orchiectomy depressed seminal vesicular weight in both stressed and control animals. In the control group, supplementation with testosterone at both levels produced a significant increase in seminal vesicular weight. Cold stress appeared to either block the action of, or render the target tissue unresponsive to testosterone given at the lower dosage rate. Since supplementation with testosterone at the higher rate in cold stressed animals did significantly increase seminal vesicular weight, it would appear that a stress related factor(s) may antagonize the trophic effect of testosterone upon the seminal vesicles. Thus the data support the hypothesis that cold stress may in fact contribute to a diminished reproductive capability.

#Second Award - United States Navy

A COMPARATIVE, ECOLOGICAL, TAXONOMICAL, DISTRIBUTION, AND REPRODUCTIVE POTENTIAL STUDY OF THE THREE SPIDER SPECIES: *LATRODECTUS MACTANS*, *L. VARIOLUS* AND *L. GEOMETRICUS* IN THE ISLAND OF *PUERTO RICO*

Rios, Juan M. CROEM High School, Mayaguez, P. R. 00709;
Urb. Baralt, Calle Principal J-4, Fajardo, P. R. 00648.

During a trip around the island of Puerto Rico, I observed three species of spiders whose peculiar traits called my attention. The names of these spiders were: *Latrodectus mactans* (the Black Widow), *Latrodectus varioulus* and *Latrodectus geometricus* (the Brown Widow).

The main objectives of this study were: to identify the different localizations of these species in Puerto Rico, to compare their reproductive potential, to identify possible natural enemies of these species and to find how the climatological factors can affect their distribution, way of life and population densities of these species.

During the study a great number of samples were collected during different seasons. Their collection was made in a an area of fifty square meters. Those samples as well as the webs were measured to find out any relationship between them. Also during each season for four hours (every half hour) environmental parameters were taken. These were taken to try to establish a relationship between the environmental parameters and the season's population density. A great number of egg sacs, from each species, were used to find out reproductive potential of these spiders. Some natural enemies were investigated.

Study showed *L. mactans* and *L. geometricus* are distributed all over Puerto Rico. A relationship between population density and environmental parameters was found. The higher the relative humidity, the lower population density per season. The higher the environmental temperatures the higher the population density.

A natural enemy for *L. mactans*, the wasp, *Desantisca abadosis* was found. It introduces itself into the egg sac. This will probably cause a partial extinction of the species.

THE EFFECTS OF AN ELECTRO-MAGNETIC FIELD ON DROSOPHILIA

Sletten, Tony W., Laporte H.S., Laporte, MN 56461;
Route 1 Box 32

Hypothesis: Will Drosophilia Melanogaster (Fruit Flies) living in a population cage that is in a magnetic field, experience any behavioral or physical changes in a 90 day period?

Procedure: After doing extensive research on my project, I started to gather all of the supplies that I would need. I built 4 boxes that would hold the flies. I then wrapped 3 of these with different amounts of 24 guage copper wire. I used 2 battery chargers for transformers. I started my project on November 1, 1982, and finished on January 30, 1983. I recorded every 4 days in my notebook any physical changes. I also wrote down any behavioral effects, and how many flies were in the main chamber each day.

Conclusions: Based on my experiment, I found that the flies in Box-D (300 wraps of wire) hardly ever went to the main chamber, while Box-A (the control) flies were in the chamber quite frequently. There was almost twice the amount of living flies at the end of the 90 days in the control box as there was in the box with 300 wraps of wire. There was no physical changes as far as I could tell, and there was approximately the same amount of dead flies at the end in all 4 boxes.

RELATION OF DOSE OF RADIATION TO FERTILITY IN FRUIT FLIES AND VISUAL MUTATIONS

Rusche, Kristin M., Evansville, IN 47714, Reitz Memorial H.S.
802 Wiltshire Drive, Evansville, IN 47715

For my project, I bred approximately 20 fruit flies until I had about 200 flies. The flies were divided into groups of 20--10 female, 10 male. I took the 8 vials to St. Mary's where Dr. Alvan Korba radiated them. Each vial had 10 rads more than the one before. The result was one vial each with 10, 20, 30, 40, 50, 60, 70, 80, and 100 rads.

The flies were kept in the same vials for breeding. The succeeding generations were counted. Any abnormalities were duly noted.

Each vial was labeled with the original number of rads the parent redeived and the generation. Also the vials of each generation were numbered so as to prevent loss or mixups.

AN INVESTIGATION INTO THE EFFECT OF THE LENGTH OF PHOTOPHASE ON THE BASAL METABOLIC RATE OF THAMNOPHIS SIRTALIS (COMMON GARTER SNAKE)

Young, Elizabeth A., Moore High School, Moore, OK 73160;
201 E. Ranchwood Circle, Oklahoma City, OK 73160.

This study involved the use of six Thamnophis sirtalis to determine the effect photophase length had on their basal metabolic rate (BMR). The snakes were acclimated for five days per each of the three photophases used, the first being 24 hours light, the second, 12 hours light:12 hours dark, and the third, 24 hours dark. Maintaining a constant room temperature, the snakes were weighed and their metabolic rate was measured using a respirometer. The BMR averages for each of the phases did show some variance between the different photophase lenghts, thus the results of the experiment are conclusive in that photophase length does affect the metabolism of garter snakes when other environmental factors are controlled.

DOES CAT FECES EFFECT THE HABITAT CHOICE OF RODENTS

Williams, Steve S., Vinita High School, Vinita, OK 74301
1110 W. Canadian
Vinita, OK 74301

I took cat Feces and placed it in the cage with a rodent and recorded how many times the rodent crossed the cat Feces. Then I placed four numbered grids without cat Feces in the cage with the Rodent and recorded how many times the rodent crossed the grids. I concluded that the rodent avoided being near the cat Feces and would in fact not cross it. To be sure of this, I did not feed my rodent for two days, then I placed him in a cage divided in the center with a line of cat feces. I placed the rodent on one half of the cage and on the other half I placed food to tempt the rodent. Still the Rodent would not cross the cat feces.

THE EFFECTS OF VITAMIN B IN CRICETUS

Torres, Pedro , Luis Palés Matos H.S., Santa Rosa, Bayamón, P. R.
B Street, #9, Santa Rosa, Bayamón, P. R. 00619

A look at the steps involved in this investigation will show the process we followed. We studied the effects Vitamin B had on hamsters' organism.

We used 6 hamsters - 3 experimental and 3 control. They were observed for a short time and after that Vitamin B was administered to the experimental group. The dosage started .5cc and was increased to 1cc. The following observations were made: lost of hair, increased appetite and constant hyperactivity. Two of the three hamsters became pregnant and after 33 days delivered a litter of 7 and 5 hamsters respectively. They also increased their size by one inch.

Using this data, we concluded that Vitamin B could have affected the hypofisis and thyroids. As a consequence an excess of hormones could have been produced, thus the pregnancy and increase of size. We categorized it as partenogenesis.

We propose to investigate what could produced the pregnancy asexually.

EFFECTS OF INCREASED THYROXINE LEVELS ON REGENERATION IN *RANA PIPIENS*

Dellinger, Greg W., Kossuth H.S., Kossuth, MS 38853;
Rt. 1, Box 16, Corinth, MS 38834

No Abstract received.

A STUDY OF GROWTH RATE CHANGES DUE TO ESTRADIOL-17B IMPLANTS IN ORYCTOLAGUS CUNICULUS

Giannobile, William V., John F. Hodge H.S., St. James, MO 65559;
Route 2, Box 312, St. James, MO 65559

In these series of experiments I have developed several concentrations of the ovarian hormone, Estradiol-17B. I am implanting the crystalline Estradiol-17B impregnated in a silicone rubber matrix subcutaneously in the ear of the domestic rabbit. The implant affects the anterior lobe of the pituitary to produce more growth hormone. It was hoped for the rabbits to grow at a significant rate, to a practical weight.

From the data I have collected, the rabbits have grown on the average 9-15% more than their unimplanted litter mates which were the control group. This took place in a time of one to six weeks after implantation.

Commercial rabbit operations could implement this to shorten the time for weaning the rabbits or market the rabbits at a higher weight in the same amount of time as normal rabbits. These varying implant concentrations have shown to be very feasible and could work well on a national scale, with FDA approval and further testing.

#THE EFFECTS OF 2,4-DICHLOROPHENOXYACETIC ACID ON SEMOTILUS ATROMACULATUS, CREEK CHUB

Larry Snodgrass, Palmyra High School, Palmyra, Missouri, 63461;
Route 1, Palmyra, Missouri, 63461.

Farmers in Northeast Missouri, and many other parts of our country, use the herbicide 2,4-D to control weed problems. This use sometimes results in chemical runoff or contamination of local streams. The purpose of this experiment was to test the effects of low levels of 2,4-D, such as might result from runoff from farmers fields, on a local species of creek chubs, Semotilus atromaculatus.

To determine an appropriate low level to run the tests, an approximate low toxic level was determined. A level slightly lower than this toxic level was used, which corresponds to 100 ppm, to run the actual tests.

The creek chubs were tested for operculum rate before and after they were placed in a device similar to that used by Black, Fry and Scott which involved a rotating chamber that set up a current. The fish were placed in the chamber until they were no longer able to swim against the current properly oriented, and the swimming time was noted. The fish were run through these tests before, and then again after they were exposed to 100 ppm 2,4-D.

It was found that the operculum rate increased considerably more following the orientation test after the fish were exposed to 2,4-D than before exposure. The swim times for the fish before exposure dropped initially, but within 2 days began to climb steadily back to about the same as the first run. The swim times, however, for the exposed fish were significantly decreased, gradually more each day, initially probably due only to the 2,4-D, but in later stages also because of the effects of stress on the fish caused by the 2,4-D exposure.

#Fourth Award - General Motors ISEF

#TRAIL PHEROMONES OF FIRE ANTS: EVIDENCE FOR TWO FORMS.

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6512 Wilty St., Metairie, LA 70003.

It has previously been reported that the trail pheromone of the fire ant, Solenopsis saevissima, is a highly volatile compound and that their trails disappear within 20 minutes. The present investigation was conducted to determine whether the fire ant might use more than one pheromone to mark its trails.

Fire ants, Solenopsis saevissima, were homogenized and extracted in acetone, alcohol (ethanol), ether, or water. To analyze for trail pheromones, the solvent extracts were laid in circular paths on filter paper on which percent trail following by ants was then determined.

Alcohol, ether, or water extracts of whole fire ants elicit trail following behavior in other ants of this species, while acetone extracts do not. Such differential solvent solubility suggests that ants contain more than one trail pheromone. When ants are offered competing extract trails they indicate no preference.

Studies on the stabilities of trails, which are an indication of trail pheromone volatility, present additional evidence for multiple trail pheromones. Ether extract trails remain effective for 4 hours, while alcohol or water extract trails last for at least 12 hours. A similar dichotomy in stability is observed in natural trails. Food foraging trails persist for only 30 minutes, while nest relocation trails remained effective for 12 hours or more. It thus appears that a highly volatile pheromone is used to mark short lived food foraging trails, while a less volatile pheromone is used to mark nest relocation trails.

#Third Award - General Motors ISEF

AQUATIC ECOLOGY OF THE OGDEN AND WEBER RIVER, DIET PREFERENCE OF THE ROCKY MT. WHITEFISH

Heninger Lisa, Weber High School, Pleasant View, Utah, 84404: 2898 N. 150 W. N.Ogden, Utah, 84404

Phase 1

Comparative study of aquatic life living in 4 different areas: Swift Shallow, Shallow Riffles, Water in Pools, and Swift Deep Water. Comparative study of water quality of the two rivers. Food base for two of the forage fish: Sculpins, Longnose Dace. Can quality of water determin species that exist and to what extent.

The Ohden river loods much cleaner so the aquatic life would be most prevelant. Fish would be the most prevelant in the Ogden river. The Weber river would have a higher bacteria and coliform count.

Stream samples taken. Water chemical test taken for bacteria and coliform appearance. Dissection of fish species.

The Ogden river has more aquatic incects. The oxygen test taken in the higher river areas showed the oxygen content higher. After the water has traveled through the cities the Ogden and Weber Rivers combined has deteriorated.

Phase 2

Diet selection of the Rocky Mt. Whitefish.

Aquatic insects that are most prevelant at the times samples were taken will be the most prevelant in the whitefish stomach analysis.

Dissection of whitefish.

Large fish whenever samples were taken prefered Stone Flies. Next most used were the Caddis Flies in the winter months. 3rd most used were the May Flies in the winter months. For the summer months Adult Flies were the most prefered in the smaller fish. The larger fish are searching for their food. The smaller fish will eat what is most prevelant in the river at the time of the year.

#THE VITAMIN C REQUIREMENTS OF TEXAS CICHLIDS AND THE RATE OF VITAMIN C DETERIORATION IN MANUFACTURED FISH FOOD DIETS

Young, Bethany C., Washington- Lee H.S., Arlington, Va. 22201;
3226 N. First St. , Arlington, Va. 22201

A study was conducted to examine both the Vitamin C requirements of tropical fish and the rate of Vitamin C deterioration in fish food diets. To examine the Vitamin C requirements of the fish, eighty Texas Cichlids were randomly divided into eight groups. Each group recieved one of four experimental diets of varying levels of Vitamin C for nine weeks. Growth rate was examined by weight (grams), length (millimeters) and condition factor (the relationship between weight and length) using the formula $W/L^3 \times 100 = K$. Protein and carcass analysis were conducted for each of the fish. The fish were observed daily for signs of lordosis, scoliosis, and abnormal physical appearance and activity.

To determine the rate of Vitamin C deterioration of the diets ascorbic acid assays were conducted at various intervals throughout the experiment. As Vitamin C is among the most sensitive vitamin to deterioration during storage, it was crucial to the study to be aware of the exact level of Vitamin C in the sample diets.

#Second Award - General Motors ISEF

FEED AND RUMEN INFLUENCE ON MILK PRODUCTION

Cole, Earl C., Roy High School, Roy, Utah 84067
5091 South 3100 West, Roy, Utah, 84067

The purpose of this project was to compare the nutrient differences of dairy feeds, their relationship to the activity of the rumen, and whether or not one would produce more milk than another one. The comparison was made of four different dairy feeds using three different cows for the testing proceedure. Each feed was used for a three week period of time and the consumption per cow was carefully measured. Then the volume of the milk was carefully measured and recorded to see if there was a difference in the milk produced.

A study was made of the cow's rumen to learn how it functioned. 1. It contains multiple growths of bacteria, 2. This bacteria is important in the digestion of food, and 3. It becomes a nutrient itself as it dies and is used by the cow in the digestive process.

A culture was taken from the rumen of a cow. Using thioglycollate broth (which is an anaerobic liquid) in a controlled temperature to simulate the rumen environment, colonies of rumen bacteria were grown. These bacteria were observed under a microscope and pictures were taken.

My conclusion is that by choosing a good balanced feed and combining it with healthy bacteria in the rumen the stage is set for high milk production.

#A STUDY OF FACTORS AFFECTING ORIENTATION, NAVIGATION, AND VELOCITY OF *COLUMBA LIVIA DOMESTICA*

Lamperez, Alfred J., Catholic High, New Iberia, LA 70560
506 West Main, New Iberia, LA 70560

The purpose of this project is to determine the role of solar, lunar, and terrestrial magnetic phenomena in the orientation and navigation processes of homing pigeons. This research studied the effects of three phenomena (sunspot numbers, moon phases, geomagnetic field reversal) on three variables (directional bearings, vanishing times, flight speeds). The experimental methodology for Study 1 and Study 3 required five months of virtually daily pigeon releases in which flight behavior and speed were recorded for comparison to daily sunspot numbers and appropriate moon phases. In experimental procedures for Study 2, a false magnetic field generator was created for use in the transportation of several pigeons to release sites. Releases were made in both clear and overcast weather conditions, and a computer program was created to compute homing speeds. Only flight velocity was influenced by the moon phases. All variables (bearings, vanishing times, speed) were significantly influenced by sunspot changes and the artificial field mechanism. This indicates that changes in a bird's magnetic environment, such as those caused by solar activity and artificial magnetic field reversal can cause significant behavioral changes. Knowledge of the differential magnitude of these effects contributes to the understanding of mass migratory behavior, as well as newly discovered aspects of human psychology and physiology, and mechanical guidance systems.

#Fourth Award - General Motors ISEF

#EFFECT OF HUMIDITY FACTOR ON BODY COLOR OF THE GRASSHOPPER, ACRIDA LATA

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366-41, Maekaizuka-cho, Funabashi, Chiba, Japan Zip 273

The body color of Acrida lata MOTSCHLSKY is of green and brown types, and I observed that the color types are changed especialy by the factor of humidity in their life history.

Therefore, many individual grasshoppers were bred in the laboratory, and the body color of the forewings were checked on each one against the standard color of the "Process Color Chart Book". Three experiments were carried out and the results are as follows:

1) The percentage of color changes was set up in the laboratory under different humidity conditions, and used for measurment of the body color of their life stages from nymph to adult. Under a high degree of humidity (70-90%), the brown type changed to green. In low degree humidity (50-60%), the green type changed to brown.

2) The activity point, which is an active or inactive score in movement, was observed. The green type population had a high point value at a high degree of humidity (77%), but the brown type showed a high point value at a low degree (50%).

3) Preference of habitat as their living places was observed. And the data was checked by the method of inductive statistics. The green type selected the tall grass community of Miscanthus sinensis ANDERS, and the brown type preferred the short grass community, Digitaria ascendence HENR, as their habitat. The Miscanthus community had a much higher degree of humidity in the canopy than the other in nature.

#Fourth Award - General Motors ISEF

THE USE OF DETERGENTS IN NEMATODE CONTROL

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Star Route 1, Box 4739, Andrews, TX 79714.

The purpose of this project was to show whether or not detergent could be used as an effective method of controlling nematode infection of plants.

In the experiment, soil that was known to be contaminated by nematodes was placed in planting trays. In each tray, 3 rows of pea seeds were planted. Each row contained 10 seeds. The first tray on each level of the planting rack was left as a control. To the second, third, and fourth trays 5 grams, 10 grams, and 15 grams were added, respectively. The plants were watered regularly and allowed to grow. Everyday the trays were rotated to assure that each plant received the same amount of light and heat.

When the plants had grown to the proper height, they were removed and examined for nematode induced nodules. The number of nodules on the roots of the plants were recorded. With 58 degrees of freedom, t-values of 7.47, 8.19, and 8.42 were obtained for 5 grams, 10 grams, and 15 grams, respectively, when they were compared to the control.

The nematode infection was greatly reduced with 5 grams of detergent for each 216 square inches of soil. The detergent may have slightly affected the growth of the plants, but any detergent effect on the plants was very small. The calculated commercial cost of this treatment is $241 per acre.

A SCATOLOGICAL ANALYSIS TO DETERMINE IF THE PARASITIC NEMATODE LEVEL IS ELEVATED BY CONTAINING WHITE-TAILED DEER

Caroline Horton
Grand Blanc High School, Grand Blanc, MI 48439
418 Hattie, Grand Blanc, MI 48439

My project makes a comparison between contained white-tailed deer's nematode levels and the nematode levels of wild white-tailed deer throughout the state.

I made this comparison by obtaining scatalogical samples of a contained deer herd at a Fisher Body Plant near my home. I took the samples and analyzed them for nematodes, using a special recipe sent to me by the Department of Natural Resources. I them compared my results to the results the Department of Natural Resources sent me of wild White-tailed deer they had studied.

From my research I concluded that contained White-tailed deer, such as I studied, have a signficantly higher level of a particular type of nematode, the nematodirus, than wile White-tailed deer.

A nematodirus is one type of nematode parasite that lives in the stomachs and intestines of many ruminants including deer. It consumes nutrients that the deer takes in. This causes no problems if the animal is well fed, but if these deer were released, or for some other reason their food supply was depleted, their survival potential would be questionable.

Since some of the deer from the herd I studied are periodically released every two to three years, I recommend that prior to a release of these deer they be given a worming medicine, such as Levemasole, to kill their nematodes and give the deer a better chance for survival on their own.

#IDENTIFICATION OF THE SITE OF ESTERASE 6 SYNTHESIS IN *DROSOPHILA MELANOGASTER*

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The study of reproductive senescence, which can be measured by decreasing levels of protein synthesis, might provide a greater understanding of the aging process. To study the process of aging through its connection with protein synthesis, anterior ejaculatory ducts (AEDs) from male reproductive tracts in *Drosphila melanogaster* were examined in an *in vitro* culture system. Virgin male *Drosophila melanogaster* AEDs were dissected from two laboratory inbred strains,. noted Dm 145, the experimental strain and Dm 100, the control. Following dissection, the organs were placed in a medium containing transcription buffer and tritiated leucine, a radioactive amino acid. The AEDs were homogenized and a portion of the homogenate was used to precipitate proteins. The remaining homogenate was electrophoretically separated on a polyacrylamide gel. The four lanes of the gel contained the following respectively: purified esterase 6; Dm 100 null AEDs; Dm 145 active AEDs, and purified esterase 6 again. Fluorography was performed in order to show levels of protein synthesis that had occurred. The Dm 145 sample banded to the exact location and intensity as the purified esterase 6. The Dm 100 sample lacked the band for esterase 6. Thus, one site of synthesis of esterase 6 in *Drosophila melanogaster* is the anterior ejaculatory duct. Through this research it will be possible for scientists to conduct further investigation concerning the role of esterase 6 in the aging process.

#First Award - United States Navy
Third Award - General Motors ISEF

#A NEW AVIAN SEXING TECHNIQUE USING MICROSCOPIC FEATHER ANALYSES

Jarman, Todd, Roy H.S., Roy, UT 84067;
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Many avian species are almost impossible to sex and determine age macroscopically because they are identical in appearance. No reliable technique for avian sexing and aging, based on feather characteristics has been developed. Some work has been done with game species using wing measurements, but with less than the best of results. Sex and age criteria are vital to know for domestic bird fanciers, and poultry & game bird managers as these indicate such things as population health, molt sequence, hatch and brood rates, as well as identification for the development of brooding stock and commerce.

The objectives of this study are: 1. To determine avian age based on feather characteristics (i.e., color, size, shape, length and presence or absence of barbs, barbules, barbicels, etc.) with 95% reliability. 2. To determine avian sex based on feather characteristics with 95% reliability. 3. To determine what influence nutrition plays on feather characteristics. 4. To determine differential feather structure between domestic and wild species.

Results indicate that sex and age can be determined by microscopic analysis of the nape feathers taken from poultry, jungle fowl, Bob White quail, and Coturnix quail. These findings have been confirmed by the Department of Zoology, Division of Genetics and Developmental Biology at Brigham Young University. Nutrition effects on feather growth, and differential structure between wild and domestic species research is continuing.

#First Award - American Veterinary Medical Association
First Award - Eastman Kodak Company
First Award - General Motors ISEF

#A PESTICIDAL BIOCHEMICAL STATISTICAL ASSAY OF *MACLURA POMIFERA*

Malone, Marchea, Grants H.S., Grants, NM 87020;
1324 Dona, Grants, NM 87020

During phase three of experimentation the protein molecule of the *Maclura pomifera* was characterized as being acidic and fairly large. It is the intent of this project to identify the amino acids present in the apple and thus the eradicating agent. Before the *Maclura pomifera* can be declared a feasible pesticide it is imperative that the significance of the treatment on the organism death rate be determined.

After amino acid fingerprinting tests were performed the R_f values of *Maclura pomifera* were compared to those of standard amino acids. Through the correlation of R_f values, the presence of four amino acids was determined. These amino acids were Lysine, Aspartic Acid, Alanine, and Valine.

The spectrophotometer readings of the three DEAE columns performed last year and the percentage of kill on aphids and sow bugs were utilized in the pearson-product-moment formula. The degree of confidence in a linear regression analysis is thought to be strong if the rho approaches one. DEAE column one rho was .9350, the rho of DEAE column two was .9825, and .9099 was the rho of DEAE column three. These numbers represent a strong positive relationship between the *Maclura pomifera* treatment and the aphid and sow bug death rate.

Four years of experimentation have determined that the *Maclura pomifera* is a significant eradicator of sow bugs and aphids. The protein was shown to be the killing agent. Perhaps the *Maclura pomifera* can be a potential pesticide of tomorrow.

#Second Award - General Motors ISEF

Title: The Effect of Fertilizer on Young Freshwater Shrimp

Author: Sadpha Bennett
School Address: Oberlin High School
Lawrence Tavern P.O, St, Andrew.
Jamaica W.I.

This project investigates the effect of Agricultural fertilizers on young freshwater shrimps. The project was done to see if fertilizers have contributed to the decrease in the shrimp population noticed in recent years. The reason why this project was chosen was the fact that the topography of most of Jamaica is hilly and not many farmers practise soil conservation. As a result of this when fertilizer is added to the soil it erodes downslope into small streams and eventually into rivers where the shrimps live.

The method we used was to choose three similar shrimp habitats along the Wag Water River. A number of shrimps were caught and placed into an acquarium at school which contained aerated tap water. The shrimps were allowed to acclimatise for four days and their normal heartbeat found. From the acquarium, daily experiments were carried out using various concentrations of the following fertilizers: Poultry manure, Sulphate, Potash, NPK 12:24:12, NPK 6:6:18.

The shrimps were placed into the following concentrations of fertilizer solution made in distilled water. 0.1, 0.25, 0.5, 1, 5, 10, (grams/litre). In each solution the average heartbeat was found. All heartbeat counts were done for five shrimps and five times for each shrimp; The result showed an overall decrease in heartbeat rate as fertilizer concentration increased. A number of shrimps died at the higher concentration levels. Poultry manure was most harmful to the shrimps, while NPK 6:6:18, affected them the least. These results seem to re-emphasize the need for soil conservation.

#FORMULATION AND IMPLEMENTATION OF A FEASIBLE DAIRY CATTLE FEED RATION

ROPELATO, ROB A., Weber High School, Pleasant View, Utah 84404
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The development of a cost efficiant dairy ration composed of commodites that are obtained cheaply throughout the intermountain area.

To begin my research, I obtained the required minimum daily requirments for lactating bovine. Usuing these figures as a starting point I proceeded to divide a herd of 250 test cattle into four varring production groups:

(1) 90 lbs. of milk per day and above
(2) 70 - 90 lbs. of milk per day
(3) 40 - 70 lbs. of milk per day
(4) All 1st lactation heifers

The last group, (4) , is needed because of the extra requirement of nutrients needed for the growth still to take place.

After charting the nutrient levels of the commodities I then catered each of the four rations to the levels of differing production.

I have implemented my research into our feeding program with some limited success. To date I have been unable to collect any data regarding increased milk production due to stress factors on the animals. A fecent move to 3-time per day (3x) milking.

I hope to have these figures available by mid-summer for further implimentation for dairy farms.

#First Award - American Veterinary Medical Association

#IMPLICATION OF BARN OWL POLE BOX PLACEMENT IN THE NORTHERN WASATCH FRONT AREA

Day, Darin, Roy H.S., Roy, UT 84067;
5015 S. 2675 W., Roy, UT 84067

The traditional habitat of the Barn Owl (*Tyto alba*) is diminishing in the Northern Wasatch Front area of Utah due to urbanization and new farming techniques. The objectives of this study are: To make a 5-year pellet analysis on Barn Owls in the study area. To determine Barn Owl diet modifications and delineation of hunting territories. To place pole boxes and study the implications of pole box placement.

Pellet analyses from 1979 to the present actually indicate an overall population increase, partially due to the use of artificial nesting boxes. Seven major hunting territories have been identified in the area covered by the study. Voles (90%) are greatly preferred over other prey species i.e., harvest mice (7%), starlings (1%), sparrows (.06%), deer mice (.05%), and shrews (.04%). Photographic behavior analyses have led to the development of a new artificial nest box design, and arrangements have been made to place the nest boxes on telephone poles and trees in each of the seven territories. Four are now in place. The pole boxes supply adequate roosting, nesting, protection against weather conditions, and against predators and vandalism. These nesting boxes are being placed near barns, haystacks and ditches where owls pass during the night while hunting. Each box is modified to accomodate the existing conditions of weather and protection.

Plans are being made for a rodent tagging and pellet retrieval system to be set up on the Antelope Island site in the Great Salt Lake with state approval. National Geographic Society has become aware of the project and will greatly contribute to public awareness of the Barn Owl situation by publishing an article on the study, which will appear in "National Geographic World" this fall.

#First Award - United States Army
Third Award - General Motors ISEF

BOBWHITE QUAIL (COLINUS virginianus) HABITAT INVENTORY AND ANALYSIS

Dabbert, Brad, Ardmore H. S., Ardmore, Oklahoma 73401
504 Cottonwood, Ardmore, Oklahoma 73401

Many people have tried to increase quail populations through such management techniques as predator control and restocking. These techniques are successful for a short time only. This is because the existing quail habitat cannot support more birds than it already has. To increase quail populations quail habitat must be increased.

This project is an investigation into three quail food plots to find out which is the best quail habitat. Four tests were used to find this out.

TEST #1: This test is to find out the density and relative frequency of quail foods on each site. A plant inventory was done on each plot to find this out.
TEST #2: This test is to find out the diversity of quail foods on each plot.
TEST #3: This test is to find out the amount of woody cover on each plot. If quail do not have protection nearby their food source, they will not feed.
TEST #4: This test is to find out the location of quail on the plots.

CONCLUSION

Although plots 2 & 3 had more quail food, they do not have adequate cover to protect the quail from predators. Plot #1 was determined to be the best quail habitat of the three. It has the most diverse quail food, the best woody cover, and this plot was the only plot on which quail were found. Plots #2 & #3 could become good quail habitat if they were planted with woody cover such as greenbriar.

CARTILAGE FORMATION IN NORMAL AND POTENTIALLY MICROMELIC CHICK LIMBS

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Micromelia (abnormally short limbs) is a largely skeletal defect found in the legs, but not wings, of chick embryos exposed to organophosphate (OP) insecticides. When and how does it arise? Not only has no one determined how limb skeleton development may be altered by OPs in embryos younger than 6 days, but there is no histochemical background detailing earliest chondrogenesis (cartilage formation) even in normal limbs. Therefore I studied the beginnings of limb chondrogenesis, comparing wings with legs and untreated with OP-treated limbs up to day 6.

I injected eggs at 2 days of incubation with corn oil or with 1 mg of the OP insecticide diazinon in corn oil. Embryos were recovered 1½-4 days later, prepared for histological study, and stained with Toluidine Blue O, which indicates cartilage by a change in color (metachromasia). Serial sections from all 4 limbs of 28 embryos were examined for metachromasia: its presence, intensity, and amount (the number of sections showing it divided by the number of sections containing that limb).

In both wings and legs, faint metachromasia appears at 4½ days and increases in intensity to day 6, with maximal intensity being equal in limbs of the same age. Wings have proportionally fewer metachromatic sections than legs at 4½ days but equal them by day 6. Treated limbs resemble controls except at 5½ days, when the legs are less metachromatic.

Concluding, chondrogenesis begins in wings and legs simultaneously, at 4½ days, but proceeds at unequal rates to day 6. Diazinon may exert its earliest effects upon legs by reducing chondrogenesis at day 5½.

Finding a cure for defects such as micromelia requires first understanding how they differ from the normal in their initiation and development. My observations are a first step toward this understanding.

#THE ELECTRICAL STIMULATION OF REGENERATION

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807 N.W. 10th Street, Andrews, TX 79714.

Evidence has been put forth that indicates regeneration can be induced by an artificial electrical stimulus. The purpose of this study is to break down the different aspects of regeneration and to explore the effects of a .12 v electrical current on those aspects.

The current's effect on the rate of cell division in the procaryotic cell, E. coli, was determined by comparing the optical density growth curves of stimulated to unstimulated cultures.

The effect of the current on the cell division of the eucaryotic cell, Paramecium caudatum, was determined by using a hemacytometer to count cells per ml of both stimulated and unstimulated cultures. Cells were counted initially, after 24 hours, and after 48 hours.

The current's effects on cell differentiation was examined in the metamorphosis of Manduca sexta. The effect of electricity on both going into pupation and completing metamorphosis after becoming a pupa was tested. In each experiment, one worm/pupa was placed in woodchips, the other 2 in foil cradles, one bathed in an electrical current and the other unstimulated.

Electricity's effect on cell division and differentiation combined was explored in the embryo development of Oryzeas latipes. Dugesia tigrina was used to illustrate the effects of electricity on complete regeneration after an injury. After the planarians were sliced in two, procedures for both organisms were the same. Each was divided into stimulated and unstimulated cultures. The amount of development was recorded and compared.

#Second Award - United States Air Force
Fourth Award - General Motors ISEF

#THE RESTING POTENTIAL OF ORTHOPTERON MUSCLE FIBRE

El-Mahmoudi, Hani W., Victoria H.S., Victoria, TX 77901;
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The origin of the resting potential in the muscle fibres of insects is of interest to electrophysiologists due to the unusual ionic distribution between the sarcoplasm and the haemolymph. The resting potential in most cells is thought to arise primarily from the characteristic ionic selectivity of the membrane. The resting potential of the frog muscle fibre, for example, can be explained by assuming that the membrane is mainly permeable to K^+ and Cl^- and slightly permeable to Na^+. However, the concentration differences of these ions in insects do not agree with this system. Other mechanisms may maintain the resting potential in insects:

(1) the distribution of another permeable ion (K^+);
(2) membrane permeability characteristics different from those found in frogs;
(3) the existence of an active electrogenic "ion pump."

All experimental recordings were performed on the flight muscles of the cicada and the field and house cricket. After the insects' dissection, a technique which permitted continuous perfusion of the muscles was devised. Use of micro-electrodes facilitated *in vitro* experimental recordings. In investigating the mechanisms by which the resting potential is produced in orthopteron muscle fibre, both membrane permeability characteristics and active metabolic processes were considered. The gained results supported the researcher's hypotheses. Thus, if K^+ is transported out across the membrane electrogenically and allowed to return through the membrane down its electrochemical gradient, a steady state potential would be generated. From this knowledge, many benefits can be derived such as creating a more highly specific pesticide.

#First Award - United States Air Force
Third Award - General Motors ISEF

THE EFFECT OF AMPICILLIN ON THE GROWTH OF RANA PIPINES

Michael P. Jahn
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The United Nations estimates that 460 million people do not receive an adequate amount of food. The use of antibiotics to grow larger animals in aquacultures, may be a small but useful method to aid undernourished people in the world.

The purpose of the project is to investigate the effect of ampicillin on the growth of Rana pipien tadpoles.

Tadpoles were used because of their rapid growth and as frogs, can be used as a food source. Ampicillin was used because it is a broad spectrum antibiotic and is one of the most widely used drugs prescribed for humans.

One week after hatching, 25 tadpoles were placed in four bowls containing one liter of water each. Each week 50, 150 and 250 mgs of ampicillin was added to each group respectively. The fourth bowl was the control group.

The maximum growth difference was during the fourth week, when the 50 mg group was 30% longer than the control group. The 250 and the 150 mg group died after 6 and 7 weeks respectively. The weight difference at the end of 7 weeks between the 50 mg and the control group was .7g (24% heavier). The length difference was 12.2 mm.

Ampicillin does effect the growth of Rana pipien tadpoles. This project is a beginning but raises many new questions such as: would the drug effect the quality and quantity of eggs produced after mating and does the increased size have an equivalent increase in the size of the adult frog.

#THE ADVANCED STUDY AND RESEARCH OF FIRE ANTS AND THE ENVIRONMENTALLY-SAFE FIRE ANT PESTICIDES

Boutwell, David Wayne, C. H. Yoe High School, Cameron, Texas 76520
706 East 8th., Cameron, Texas 76520

PURPOSE: The purpose of my project is to continue the study of Fire Ants and research in the field of environmentally-safe fire ant pesticides; to improve my new more efficient and effective pesticides, and to phase out the older, ineffective pesticides I have developed. **PROCEDURES:** In the 1979-80 research, I experimented with the wood ash and water (Proc.#1) forming lye, applied directly to the ant nest. In the 1980-81 research, I experimented with the mold (Proc.#2) and the grease bait and lye solution (Proc.#3). The mold, grown from sugar water and bread, was applied by spreading it in powder form to the nest and adding water. The grease bait, a mixture of lye water (wood ash/water) and cooking grease dried to form pellets, applied to nest. In the 1981-82 testing, I experimented with cornmeal bait (Proc.#4). The cornmeal bait was made by mixing lye water (wood ash/water), mixing it with cornmeal and baking. The cornmeal crumbs were spread near the fire ant nest. In the 1982-83 research, I phased out the inefficient methods-Proc.#1,2, and 3, and have continued to experiment with method #4, performing tests such as testing mice with small doses of lye-cornmeal bait to determine if dangerous to vertebrates. I also tested the PH of runoff from test areas to determine if runoff into rivers and streams used as water supplies were adversely affected. The final test was to construct a metal box in order to isolate nests to obtain accurate test data. **RESULTS:** The regular lye (Proc.#1), the mold (Proc.#2), the grease bait (Proc.#3) all were successful in killing Fire Ants. Through the cornmeal method (Proc.#4) I have solved the problem of large-scale application. The PH tests were negligible. Test animals had no ill effects.

#Honorable Mention - United States Air Force

ENVIRONMENTAL SCIENCES

#THE FORMATION OF MICRO RILLS LEADING TO SOIL EROSION

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In a previous study, using a computer simulation, I investigated raindrop accumulation on a dry, horizontal surface. The project illustrated the formation of "wet" spots. In this year's computer simulation, I slightly tilted the surface such that the "wet" spots began to flow, initiating rill erosion on a micro scale. Various rill patterns were created by using different infiltration rates. An attempt to use R.E. Horton's law of order, and length ratios was unsuccessful. But by calculating the total rill length in one area (drainage density), a numeric value was given to the various rill patterns. This number discriminates well between the different infiltration rates. The computer simulation was verified by a physical model of micro rills on a sandy slope.

#Second Award - American Society of Civil Engineers
Second Award - General Motors ISEF
Second Award - United States Navy
Fifth Award - American Association of Petroleum Geologists

A STUDY OF THE EXTENT TO WHICH SO_x AND OTHER POLLUTANTS ARE TRANSFERRED FROM THEIR POINT OF ORIGIN

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The difference in amounts of Total Nitrogen, the soil pH, and the amount of sulfate-sulfur in soil samples were used to establish the probable extent to which pollutants are concentrated in the soil at five different sites in the area near a smelter which emits SO_x and NO_x compounds. Differences were found which suggest that (a) the area closest to the smelter was affected more than those sites separated from the smelter by distance and (b) that abnormally high concentrations of sulfate-sulfur at a canyon site twenty miles away could be due to the acid rain effect of the smelter emissions. Further long range studies need to be conducted to determine the exact origin and extent of the problem.

THE EFFECTS OF CERTAIN MAN-MADE STRUCTURES ON BEACH EROSION

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This project has a dual purpose: To demonstrate the effects of certain man-made structures on beach erosion; and to inform the public of beach erosion, namely, its causes and its cures. I have served these two purposes by setting up a model beach environment to determine how beach erosion is controlled by sea walls and artificial reefs.

The results of this experiment indicate that sea walls increase beach erosion and artificial reefs decreases beach erosion by decreasing wave power. Beach erosion poses a serious threat to the stability of our coastlines. However, it receives little publicity. Perhaps if more people came to realize the intensity of the erosion problem, more people would want to help. If my project teaches one person about beach erosion, I will feel it has been a success.

FLORA AND FAUNA IN PLEASANT VIEW AND OTHER SELECTED AREAS.

Schneiter, Troy L., Weber H.S., Pleasant View, UT 84404;
2868 N. 150 W., North Ogden, UT 84404.

Natural flowing springs, heated deep in the earth, have attracted mankind for centuries to bathe and soak out body aches and pains. As in days of old many of these hot springs are still used for recreational purposes.

Water, Algae and soil samples have been obtained from hot springs located in northern Utah and Idaho for analysis. The analysis indicated that all of the springs contain similar and/or same species of algae, which are commonly found in open water, but which have adapted themselves to live in the constant temperature hot water.

#A TWO-YEAR STUDY ON THE EFFECTS OF ACID RAIN IN LOUDOUN COUNTY, VIRGINIA

Beaver, Hilary A., Loudoun Valley High School, Purcellville, VA 22132;
Box 157A, Waterford, VA. 22190

I measured the relative endurance of Loudoun County soils against acid rain. Seventeen Loudoun soil associations were dried, and duplicate one-gram samples were combined with 20 ml 0.1 N H_2SO_4. After ten days, 20 ml of water were added, the mixture was heated to drive off CO_2, cooled and back-titrated with 0.1053 N NaOH to determine the total milliequivalents of H_2SO_4 neutralized by the soil. The pH of the same soil associations was found by combining soil samples with distilled water. A Corning Model 10 pH Meter and phenol red indicated the pH.

Results were compared with percolate pH readings of the same soil associations, which had been percolated with simulated acid rain (H_2SO_4, pH 3.0) in 1981-1982. These experiments divided the soils into four groups: (1) Soils/rocks which have high milliequivalent values relative to their percolate pH, releasing ions slowly and retaining their buffering capacity the longest — Limestone conglomerates, sandstone, and Athol-Emory are in this category. (2) Soils with high percolate pH but relatively low milliequivalent values — These release their ions rapidly when exposed to acid, quickly exhausting their total buffering capacity; examples are humus, red shale, and silt loam. (3) Soils with intermediate percolate pH and milliequivalent values — These soils have some useful buffering capacity and retain that capacity for a reasonably extended period. These include Athol-Emory, Meadowville, and Greenstone. (4) Six associations showed little or no useful buffering capacity; they were highly acidic in themselves, produced a percolate of low pH andhad low or negative milliequivalent values. These included Brandywine, Braddock-Thurmont, Glenelg-Manor, Penn-Calverton, Airmont, and Penn-Bucks.

#First Award - American Society of Agronomy
First Award - U.S. Department of Energy
Second Award - National Oceanic and Atmospheric Administration
Third Award - General Motors ISEF

THE DETECTION OF CONTAMINANTS IN FOOD STOCK FOR DOGS

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In my project I have the following problem: Determine whether contaminants are present in dog food and if these contaminants caused the cataracts in the litters of puppies. Looking at possible causes for the cataracts, I have ruled out living conditions; the dogs are kept in pens with no apparent contaminants. I have eliminated drinking water, because three puppies have been born without cataracts from drinking the same water. I have eliminated hereditary possibilities because there was no evidence of cataracts in any of the parents. This leaves the conclusion that the most probable source of contamination is in the dog food. I then found a test that would detect a mutagenic or carcinogenic agent in my dog food. It was developed by Dr. Bruce Ames and is called the Ames Test. I inquired about the use of the test at Iowa State University and the University of Iowa. At the University of Iowa, graduate student Ayers was running similar tests. She demonstrated it's use to me and then helped me run the test. My results show possible mutagenticity in one test, but one half of my sample plates contained bacteria contaminants. I have concluded the dog food probably contains bacteria contaminants. More experimental work is necessary to determine further results.

#AEROSOLS AND THE OZONE LAYER

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The purpose of my experiment was to find out if fluorocarbons really have an effect on the ozone layer. I did this by using my own original experiment.

First, I made my own "ozone layer" within an air-tight box by creating an electrical discharge from a transformer. This discharge, in turn, created ozone.

I prepared my ascorbic acid, iodine, and starch solutions. I prepared the ascorbic acid in 10%, 1%, and .1% concentrations. I divided these into three groups of thirty milliliters each. I sprayed one group to react with air. I sprayed another group of solution to react with ozone. I sprayed the final group of solution to react with ozone previously reacted with freon, then mixed one milliliter of each of the nine solutions with one milliliter of starch solution. With a burette, I added the iodine solution until the I_2 mixed with ascorbic acid, and began to turn the starch purple.

It took the greatest amount of iodine to react with the ascorbic acid that had reacted with the ozone and freon. This was because the freon reacted and broke down the ozone, allowing the excess of ascorbic acid.

I concluded that fluorocarbons can break down the ozone layer.

#First Award - American Meteorological Society
Third Award - National Aeronautics and Space Administration

THE ROLE OF SURFACE WAX IN RELATION TO THE EFFECTS OF SULFURIC ACID, A COMPONENT OF ACID RAIN, ON PHASEOLUS VULGARIS

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The relationship between cuticular wax quantity and necrosis caused by 2.5 pH and 3.5 pH sulfuric acid applications, ranging from 5 to 20 ml, on *Phaseolus vulgaris* at 8, 11, and 16 days was investigated. Hypotheses were: (1) The greater the quantity of surface wax the less necrotic injury incurred when plants were misted with two solutions of sulfuric acid. (2) The lower the pH value of the sulfuric acid solution, the greater the damage incurred. Eleven-day-old plants exhibited the most injury and had the lowest surface wax quantity; eight-day-old plants exhibited the least injury and had the greatest surface wax quantity. The 2.5 pH sulfuric acid solution caused greater necrotic injury than the 3.5 pH sulfuric acid solution at the same day. Those plants misted with distilled water, the control group, exhibited no necrotic injury.

Analysis of data led to conclusions which support both hypotheses.

Other observations led to the following hypothesis. The loss of moisture shown among those plants misted with a sulfuric acid solution was possibly related to injury to epidermal cell membranes and/or plasmolysis.

#AGENT ORANGE COMPONENTS; 2,4-D, 2,4,5-T: A STUDY OF TOXIC REACTIONS ON CHICKEN EMBRYO MORPHOLOGY

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Exposure to the herbicide Agent Orange, consisting of 2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), is proported to cause such conditions as birth defects, cancer, dermatitis, and neurological damage to Vietnam veterans and people who casually used it in the United States. Because of a dearth of documented research validating such a cause and effect relationship, this study investigated the two components of Agent Orange on the morphology of the developing chicken embryo.

On day seven of incubation the chicken embryos were exposed in proportion to egg size, either .025mg/g or .0125mg/g of 2,4-D, 2,4,5-T, or Agent Orange at one of four sites: yolk, air cell, egg shell membrane, or egg shell. Very strict controls were maintained for all 143 embryos. Four days prior to hatching, embryos were examined by nine linear body measurements, vital organ masses, blood smears and chromatography, bone marrow, and muscle and organ thin sections.

It was concluded through analysis of variance (alpha $\leq .05$) that 2,4-D was toxic; it reduced growth potential in the embryos, and 2,4,5-T was mutagenic; it altered the embryos' structures. It may be noted that some of the very factors about which the veterans are complaining have been exhibited as abnormalities within the chicken embryos exposed to Agent Orange: molted feathers resemble a chloracne condition; livers with spots or growths indicate potential digestive system damage; the absence of a sternum and chest cavity for the 2,4,5-T embryos could be prelude to fetal malformations. This and other observed factors suggest that an environment containing Agent Orange or its components presents a potential health hazard.

#First Award - General Motors ISEF
First Award - United States Air Force

IMPACT OF CONSTRUCTION AND CULVERTS ON AQUATIC MACROINVERTEBRATES IN A SMALL STREAM

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Construction plans for the Skyline Mine Project in Eccles Canyon, Carbon County, Utah called for the portal area to be located where the Upper South Fork and Upper Middle Fork converge to form Eccles Creek. Parts of the Upper South Fork, Upper Middle Fork, and Eccles Creek were channeled through a completely enclosed culvert approximately 600 m in total length. To determine the impact this culvert had on the aquatic macroinvertebrate community, drift and benthic samples were taken. Results show that macroinvertebrate drift from the culvert was only a fraction of the drift entering the culvert. Macroinvertebrate colonization below the culvert was also shown to occur in much lower numbers than above the culvert. Using the culvert results as background information, drift samples were taken in Eccles Creek to determine the general construction impact. Drifts were taken in areas of disturbed stream and where construction may have caused a Ph change in the water. In both cases drift samples were much greater than natural drift samples. The increased drift has been found to create a stress on macroinvertebrates which hinders reproduction. The end result is a diminished food supply for fish.

#THE TREATMENT OF AN INDUSTRIAL WASTE EFFLUENT WITH *SULFOLOBUS ACIDOCALDARIUS*

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PURPOSE: To prevent a potential environmental hazard by reducing the NH_4SCN concentration from Western Zirconium's waste effluent in an economically feasible period of time.

HYPOTHESIS: That *Sulfolobus acidocaldarius*, a thermoacidophilic bacteria, will reduce the NH_4SCN concentration in the effluent.

PROCEDURE: The bacteria was collected from Yellowstone National Park. A series of four tests were performed. The first two tests used effluent diluted 1:1 with spring water. Half of the second test contained sulfur as an added nutrient. Both tests had differing concentrations of bacteria and effluent. These were incubated for different lengths of time in a hot water bath. Tests 3 and 4 used undiluted effluent with no additives. Samples of test 4 were removed every other day and analyzed to find the rate of reaction. Both of these tests had differing concentrations of effluent to bacteria and were incubated in a hot water bath. All tests had corresponding control flasks containing effluent and no bacteria.

PROCEDURE 2: The samples were analyzed for NH_4^+ and SCN^- at the Western Zirconium lab. Analytical techniques used were the Kjeldahl and the colorimetric spectrograph.

CONCLUSION: The overall conclusion is that the bacteria do consume the NH_4^+ and SCN^-. The largest NH_4SCN reductions occur in bacteria to effluent ratios of about 3:1. The addition of sulfur seems to be a hindrance to optimum chemical reduction. The rate of reaction is fast enough to be economically feasible. Finally, the bacteria can survive in a simulated environment over a period of eight months.

#First Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Third Award - General Motors ISEF

#HEAVY METAL ATMOSPHERIC PARTICULATES - LEAD ABSOPTION IN BEANS

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Lead is one heavy metal whose harmful effects at high doses have long been known. It is introduced into our environment through such common things as lead paint, gasoline additives, and junked batteries.

This experiment was designed to test a plant's ability to absorb lead introduced atmospherically. In a student-designed test environment, mung beans were exposed to automobile exhaust containing high concentrations of lead. Using a microprocessor ionalyzer, microscopic techniques, and chromatographic studies, test plants were analyzed and compared to control plants.

In all analyses, it is impossible to detect differences caused by the lead. Plant tissues remained constant and unchanged in both test and control plants. In chromatographic analysis, Rf values were similar, indicating no differences. The microprocessor ionalyzer read 0 ppm lead in each experiment, indicating that lead was not absorbed atmospherically by the test plants.

This investigation opens the doors for further experimentation with lead and its effect on plants.

#Fourth Award - General Motors ISEF

#WHAT ARE THE EFFECTS OF $HgCl_2$, $ZnCl_2$, and $NiCl_2$ ON FUNDULUS GRANDIS IN THREE 96 HOUR STATIC ACUTE TOXICITY TESTS?

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The purpose of this project was to conduct three separate 96 Hour Static Acute Toxicity Tests to find the effects of the three heavy metals: Mercuric Chloride, Nickelous Chloride, and Zinc Chloride on *Fundulus grandis*, commonly known as the Gulf Killifish or Bull Minnow.

The project was done in two stages: Stage 1 - The Fertilization and Hatching processes for the obtainment of organisms for Stage 2. Forty-five (45) gravid, egg bearing *Fundulus* were messaged for their eggs. Approximately 700 eggs were received, then these eggs were fertilized with the testes from three male *Fundulus*. With the proper care of maintaining a constant temperature of 70°F or 21°C, a constant salinity of 13^{0}/oo, constant air flow and water changes every other day, approximately 400 eggs hatched within 17 days.

Prior to the initiation of Stage 2, the young fish, fry, were maintained on Brine Shrimp for ten days.

Stage 2 - The actual 96 Hour Static Acute Toxicity Test. For each of the heavy metals, Mercury, Nickel, and Zinc, five (5) concentrations were made with three (3) replications per concentration. A total of fifteen (15) fish were used per concentration and in the controls. During the test, daily and periodic observations were recorded, noting appearance and swimming habits. All three (3) metals affected the Medulla oblongata of the fish. It was shown by a distorted equilibrium. The respiration of the fish was also affected by showing signs of rapid gill fluctuations. The Mercury and Nickel showed signs of affecting the digestive system by abdominal swelling and an over abundance of fecal material.

#Second Award - Marine Technology Society/U.S. Naval Institute

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LICHENS AS A POLLUTION REFERENCE

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Investigative studies in the field of acid rain began in the mid 1950's in Europe, but studies did not begin until 1970's in the U.S. No change was observed in the basic pH balance until the 1980's.

Utilizing H_2CO_3 and H_2SO_4, pH 4.6 as artificial rain test solutions, and applying in simulated rains on selected virgin test sites with the lichens *Physcia aipolia* (Ehrh.) Hampe and *Xanthoria candelaria* (L.) Th. Fr. as test specimens, an approximate three month study of the effects of acid rain on lichens was conducted.

Secondary investigations were conducted on pH of natural precipitation, and nitrous oxide impact from car exhaust emissions on lichens relative to highways, streets, and major city intersections.

Damage was determined by progressive photographic analysis of primary and secondary sites by color and infrared investigation.

Evidence from investigation shows lichens can be used to indicate a deposition site of acid pollution.

#CONSERVATION OF A RARE FRESHWATER HABITAT IN WEST CORK, IRELAND

Hickey, Timothy, De La Salle College, Macroom, Co Cork, Ireland;
Cloonfada, Macroom, Co Cork, Ireland

Up to 1952, the "Gearagh", situated on the River Lee, near Macroom, Co Cork, Ireland, was the last fragment of post-glacial, alluvial forest left in the British Isles. The diverse flora and fauna it supported attracted scientists from all over Europe.

In 1952 the river Lee hydro-electric scheme flooded the river valley and everyone believed the forest had disappeared.

I had always looked on the Gearagh as an open-air science classroom. From my observations I believed a small fragment of this rare hydrosere still existed and was now under threat of total destruction.

I carried out an ecological study of the area and compared my results with past scientific reports to ascertain if anything remained. I identified the threats that endanger the forest, and put forward proposals for its proper conservation.

Having located all previous reports, and using techniques similar to those used by scientists who previously studied the area, I picked five stations and studied structure, plants, invertebrates, birds and animals. I studied their inter-relationships at close quarters, and through aquariums, to acquire an overall view of the area, and I came to the following conclusions.

- The "Gearagh" retains characteristics of post-glacial alluvial forest.
- It supports a diverse flora and fauna, some of which is not found elsewhere in the country.
- It is a major wild-fowl wintering ground.
- It is an important pike breeding nursery.

The "Gearagh" is under threat. The area must be conserved for future generations through academic recognition and governmental approval.

#Third Award - General Motors ISEF
Honorable Mention - Bureau of Reclamation/U.S. Dept. of the Interior

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LEAF PRODUCTION, GROWTH RATE, AND AGE OF A TROPICAL PALM

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Sierra palm (*Prestoea montana* Nichols) is a natural component of the rain forest of the Greater and Lesser Antilles. The palm exhibits a continuous production of leaves, which upon dehiscence produce a permanent scar on the stem. In 1946 this characteristic was used to study the relation between number of scars (leaves) and height growth in a palm forest at an elevation of 550 m in the Luquillo Experimental Forest in Puerto Rico. As part of that study each individual palm was measured and notched above the highest (most recent) leaf scar. Those notched palms were relocated and utilized for this study. The objective was to determine a series of growth indices for the palms and to use growth data to estimate the age of palms. The resulting mean growth indices were: diameter - 0.33 (± 0.01) cm/yr; basal area - 6.84 (± 0.37) cm^2/yr; height - 0.14 (± 0.01) m/yr; stem volume - 0.03 (± 0.002) m^3/yr; and leaf production - 4.20 (± 0.14) leaves/yr. Average internode distance was 4.3 cm. The production of leaves in the palms studied proved not to be constant ranging from 2 to 5 leaves per year. Annual leaf production was positively correlated ($r = 0.64$, $p < 0.01$) with height. This correlation was used to estimate ages of individual palms (range from 44 to 67 yrs). The distance between leaf scars was indicative of plant vigor and growth. It was found that individuals that dominant palms grew fast when they were small and slow as they reached the canopy.

#THE EFFECTS OF JUVENILE HORMONE ANALOGUES ON DROSOPHILA

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This project illustrates the effects that juvenile hormone analogues have on the development of new generations of Drosophila and their effects on the existing generations.

Two JHA's, Farnesol and ZR-515, were incorporated into the medium of a population of adult virgin Drosophila. I observed daily for effects on pupatorium formation, eclosion and the life span of the insects.

Farnesol proved lethality to the existing generation of Drosophila at concentrations of .5%, 1%, and 2% solutions, the flies died within a 9 day period. In these vials there was no evidence of larva or eggs. ZR-515 decreased the life span of the Drosophila at concentrations of .0006 gm., .006 gm., and .06 gm., while at .6 gm. the flies actually lived as long as did the control. The ZR-515 also delayed the development of pupatoriums in all concentrations. Furthermore, the experimental pupatoriums failed to hatch.

My results indicate that a new generation of Drosophila never developed. Thus, JHA's allow for the control of insect populations in specific areas. This finding is significant in that JHA's may be the insecticides of the future. A very attractive aspect of JHA's as insecticides is that according to present knowledge, they have no effect on other life forms. Therefore, while controlling insect populations, there would be no adverse effect on the environment. Another advantage of JHA's is that it is impossible for an insect to build up a resistance to its own hormones.

#Fourth Award - General Motors ISEF

METHANE GAS PRODUCTION THROUGH ANAEROBIC RESPIRATION

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Methane is the product of the microbiological decomposition of organic compounds in absence of oxygen by a specialized group of bacteria. Through my project, I hope to prove that the natural, inevitable production of methane gas through anaerobic respiration of animal waste and vegetation can be controlled and the resulting gas can be captured and released as a combustible fuel. By using in my experiments harvested shoreline macrophytes common to Florida lakes, I hope to find a use for biological oxygen-demanding waste. I have developed a make-shift system using common laboratory equipment. In my experiment, I set up systems for production and one gas collecting bottle for each system. The systems consist of a 400 ml flask, with a side opening, placed in an insulated and heated container of water and connected to the gas collection bottle by rubber tubing. The collection bottle is inverted and suspended in another water container. Within the flask is a mixture of the waste product. Production time is two weeks and the experiment must be regulated carefully. To prove methane gas is present, the tube from the flask to the collection jar is disconnected and the jar is inverted, placed in a protected dark place, and ignited. If the methane is present, a faint, blue flame will appear. Methane gas production can be advantageous because it is a natural way to produce energy, while maintaining an ecological balance.

#THE EFFECTS OF VOLCANIC ASH ON THE MAMMALIAN RESPIRATORY SYSTEM

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This project was designed to determine the effects of ash inhalation on the lungs via a pulmonary-related enzyme system of Mus musculus, to determine particle size of the ash and the degree of reversibility and/or fibrosis following ten weeks' exposure to ash inhalation.

Test animals were exposed to aerosolized Mt. St. Helen's volcanic ash for ten weeks in a specially designed chamber. Histological sections, a fibrin plate assay and ash particle size determination were done.

A 35% decline in fibrinolytic activity was seen in two week subjects and continued to a low of 49% with mild recovery at 12 weeks. Trichrome stains were examined blinded and fibrosis quantitated on a 0-5 scale. Controls averaged .25 degrees of fibrosis and 10 week test animals 3.5°. Particle size determination on a polarizing microscope indicated that 88% were respirable size at less than 9.6 by Ferets' measurement and average particle size in the sample used was 1.75 . This supports previous data on ash versus silica inhalation which revealed increased macrophage invasion and metabolism rates as well as inflammation, fibrosis and ruptured alveolar walls. Particle size determination suggests that a large percentage of the inhaled ash cannot be filtered out efficiently. Data indicate that inhalation of ash inhibits normal fibrinolytic activity in the lungs of white mice. Inhibition of fibrinolysis is considered a biochemical tumor marker for patients with microscopic residual cancer. Short term exposure to volcanic ash causes irreversible fibrosis, so long term exposure could cause a silicosis-like condition which may become malignant. Potential ash damage to the respiratory system during and following volcanic eruptions could be diminished or eliminated through the constant use of facial masks.

#First Award - Navy Medical Research and Development Command
Second Award - General Motors ISEF
Second Award - United States Army
Honorable Mention - United States Air Force

IS IT REALLY RAINING ACID?

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Research to determine if acid rain is falling in Cumberland County, TN, was conducted. Four environmental settings were studied: 1) open field, 2) open field with fog interceptor, 3) deciduous canopy, and 4) conifer canopy.

Four plastic dishpans, three with rain gauges, and one with a fog interceptor were used to collect bulk rain samples from the four environmental settings. Samples were measured to the nearest tenth pH unit. These data, placed into the following equations to calculate bulk mean weighted volume of hydrogen ion concentration $[H^+]$, were: (1) Total $[H^+]$ X Total Precipitation = Total (X), and (2) Total (X) ÷ Total Precipitation = Mean Volume Weighted $[H^+]$. Resulting value was used to derive bulk mean weighted pH.

Bulk rain samples collected from September 1, 1982 thru February 28, 1983, revealed that acid rain was a clear and present danger to the terrestrial environment in Cumberland County, TN. The six-month study demonstrated that bulk mean weighted pH was 3.5 for the open field. Condensation collected by the fog interceptor decreased the acidity of the original rainfall to a pH value of 4.3. Deciduous canopy decreased acidity to a pH of 3.7. Conifer canopy slightly increased acidity to a pH of 3.4.

#STUDIES ON POSSIBLE ECOLOGICAL EFFECTS OF TWO-CYCLE MARINE ENGINE EXHAUST

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This project in its present form is the result of four years of bioassay experimentation on the effects of two-cycle marine engine exhaust water on the green algae.

The initial idea was to determine the toxicity of outboard engine lubricant. Some success with lubricant, eventually led to the formulation of "synthetic" exhaust water, which, in turn, led to the use of actual two-cycle engine exhaust water as the test substance.

Toxicity was determined by means of the standard bottle or "batch" bioassay technique. Scenedesmus quadricauda and Ankistrodesmus sp were used as the test organisms. Toxicity was measured in terms of a decrease in the maximum standing crop.

The effective concentration - 50 per cent (EC 50) for Scenedesmus quadricauda was found to be 3.75 per cent exhaust water; for Ankistrodesmus sp 3.1 per cent exhaust water using the bottle technique.

Anomalies in growth curves raised the suspicion that evaporation was affecting the results; therefore, a flow-through system was improvised utilizing the characteristics of a device called a Biomonitor. Use of the Biomonitor lessened the influence of evaporation, and the EC 50, using this improvised flow-through system, was found to be 1.4 per cent exhaust water using Ankistrodesmus sp as the test organism. Mixed populations of various algae gave an EC 50 of 1.28 per cent exhaust water.

The contributions of this project are twofold. First, the toxicity of two-cycle marine engine exhaust was found to be considerably greater than reported in the literature (1.4 per cent vs 4 2 per cent). Secondly, the benefits of a flow-through bioassay technique utilizing the Biomonitor was demonstrated.

#First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - Gulf Oil Corporation
First Award - U.S. Department of Energy

#ACID RAIN AND ITS EFFECTS ON OUR ENVIRONMENT: A THREE YEAR STUDY

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My project is a continuous study of Acid Rain and its effects on our environment. I have been working on this for three years now. The first year my project consisted of just the pH measurements taken from eight specific rain stations I picked out myself. The samples were measured with pH Universal Litmus Paper. The second year consisted of, again, continuous measurements whenever it rained on the same eight rain stations. Experiments were also conducted on microscopic animals at a pH of 2.0 to 3.0, and environmental experiments on plants and the germination of seeds. This year I have added to my project a new rain station which is a fresh water pond and also a microscopic animal to my microscopic study. I have repeated my microscopic experiments using a different pH (3.0 to 4.0) and continued my seed germination study which is listed as Phase 2. I added another environmental experiment involving oxygen in bodies of water and have been taking prevailing winds with my measurements. The measurements this year were done with a pH meter that I purchased. As on-going experiments I have started a Brine Shrimp Study and have started to analyse my samples by running sulphate and nitrate tests. My science endeavor with acid rain has been very interesting and I hope to continue my research on into next year.

#Fourth Award - General Motors ISEF

#VIRUS INACTIVATION IN AEROBIC DIGESTION OF WASTEWATER SLUDGE

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The Water Pollution Control Act Amendment of 1972 has resulted in a quest for methods to replace ocean disposal of wastewater sludges. One such method is the land application of sludge for the fertilization of soil. There remains, however, the possibility of the transport of viruses back to man due to virus breakthrough into groundwater or the contamination of the crops in the treated soil. Aerobic sludge digestion shows great promise for the killing of viruses prior to land disposal of the sludge.

An experiment was conducted to determine whether aeration directly affects virus inactivation or affects a component of the sludge that becomes virucidal as a result. Aerated and non-aerated flasks of phosphate buffered saline (PBS) and centrifuged, filtered wastewater sludge were inoculated with bacteriophage MS-2. Samples were taken at 0, 24, 48, and 72 hours after inoculation. Dissolved oxygen levels of the PBS and sludge supernatant were measured at these times, also. Each sample was pipetted into top agar along with E. coli C-3000 and poured onto nutrient agar plates. After incubating the plates at 37°C, plaques (clear spots on the bacterial lawn) were counted. Each plaque indicated one bacteriophage from the sample that had replicated (a plaque-forming unit).

The data produced by the plaque counts indicated that aeration itself only accounts for a small amount of viral inactivation. However, viral inactivation in the aerated supernatant was significantly greater than in the non-aerated supernatant and in both aerated and non-aerated PBS. It is thought that a large molecule in the sludge may be altered in some way by the aeration that becomes pathogenic to viruses.

#First Award - United States Navy
Fourth Award - General Motors ISEF

NUCLEAR WASTE: UNTAPPED ENERGY

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One of the myriads of problems facing the modern American society is the disposal of nuclear waste materials. Many of these wastes, produced by the fission of uranium and plutonium atoms, possess long half-lives and endanger the environment for decades after their production. These wastes, presently stored in underground cannisters, constantly release vast quantities of energy. This energy can be employed in the production of electrical energy by the photoelectric effect initiated in a copper shell by the electromagnetic radiation released by a central core of radioactive wastes.

The hypothesis that a photoelectric current produced by radioactive nuclear wastes is a feasible source of energy is the basis of this experiment. The testing of the idea was conducted theoretically, due to the inherent dangers of handling radioactive materials. The first step of the testing involved the collection of the necessary formulae, such as the formula for the absorption rate of the radiation by the copper shell: $R_{ab}=R_{trans}(1-e^{-\mu R})$, located in S. Glasstone's Sourcebook On Atomic Energy. The following level in the experiment consisted of the accumulation of the required physical data; such as the linear attentuation coefficient of copper, found in Lange's Handbook Of Chemistry. The third phase of testing was the evaluation of the information from the formulae and data previously obtained. The next section of the project involved the plotting and interpretting of the formulated information. The conclusion of this experiment is the photoelectric effect in copper produced by radioactive wastes is a feasible and logical source of electrical energy in locations that require the long-term, low-power production of this type of nuclear battery.

#WHAT ARE THE EFFECTS OF ACID RAIN ? (COMPUTER SIMULATION)

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This computer simulation is a mathematical representation of naturally occurring food relationships and the effects which Acid Rain has on aquatic ecological systems. In order to program the simulation, inorganic and organic aspects of Acid Rain had to be researched.

The actual organisms which exist in ponds, streams, and lakes have varied resistance and reactions to the addition of acid into the environment. Thus, in order to accurately predict the effects of Acid Rain on the ecosystem, the effects of acid on specific organisms had to be determined.

An ecologically stable food chain was established using Paramecium multimicronucleatum, Chilomonas paramecium, Stentor igneas, Spyrogyra, and various bacteria. Using combinations of microrganism culture and sulfuric acid solutions, experiments were conducted. Counts of the alive and dead organisms in each species were taken. The results were then verified by repetition and converted into percentages.

This simulation proved that after a certain level of acidity is reached, all organisms are destroyed. The objective of this project was to precisely determine the effects that Acid Rain has on a controlled ecosystem. However, the more important uses of the simulation are to diagnose environmental damage and to simulate damage, determining the results of taking "curative" measures before actually taking action.

#Honorable Mention - Gulf Oil Corporation

#AN IN-DEPTH STUDY OF BIOCONVERSION WATER PURIFICATION SYSTEMS OF THE FUTURE USING ARTEMIA SALINA

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A bioconversion water purification system using Artemia salina has been developed. This system has been proven successful in the removal of coliform and other related bacteria.

Artemia salina provide a practical, cost effective method of sewage treatment and water purification. The possibilities of using Artemia salina for detoxifying are also explored.

This study opens up a new avenues for the application of bioconversion systems as an alternative process for water purification.

#First Award - American Society of Civil engineers
First Award - National Aeronautics and Space Administration
Second Award - United States Air Force
Fourth Award - General Motors ISEF

A STUDY OF THE RED MANGROVE, RHIZOPHORA MANGLE ALONG THE SHORES OF GUAYANILLA BAY IN SOUTHERN PUERTO RICO AND THE EFFECTS OF CONTAMINATION PRODUCED BY HOUSEHOLD AND CHEMICALS POLLUTANTS ON ITS SEEDLINGS

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Urb. Stella, Calle B-28 Guayanilla PR 00656

This project comprises an ecological study of the mos common mangrove tree found in southern Puerto Rico, Rhizophora mangle, along the shores of one of the most contaminated bays in southern Puerto Rico Guayanilla Bay.

It was carried out to show that the contamination exerts an effect on the growth, the development of the seedlings and other characteristics of the red mangrove, comparing Guayanilla Bay water (high water contamination) with Tallaboa Bay water (low water contamination) that are located in the southwestern coast of Puerto Rico. Other factors affecting the growth of the plant such as salinity, ph, refraction index and sediments were examined.

To demostrate the effect of the pollutants on root development I used as indicators the development of roots and the presence of photosynthetic pigments in seedlings of Rhizophora mangle in both bays as well as the percentage of browsing.

The pollutants used were divided into household ones such as DDT gas oil, Vel and Ajax NH4 and chemical ones such as, mercuric chloride, lead nitrate, sodium sulfate and zinc sulfate.

In the Fourth year of study were used 4 pollutants, reported as present in the Bay; cd, cn, Ni and Hg in the concentrations reported the way the contamination effects the tissue was proved too.

ACID RAIN : HOW GREAT A MENACE? PHASE II

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Acid rain has been around since the world began with natural causes, such as volcanic eruptions, forest fires, bacterial decomposition and lightning bolts; but only since man and the Industrial Revolution has it progressed so rapidly.

Rain becomes acidic when pollutants, such as SO_2, NO_x, and CO_2 react with water in the atmosphere to form weak solutions of acid. It falls out with rain or snow or as dry particles to become acids. The pollutants come from coal and oil burning power plants, vechicles, smelters, and industrial sources.

After trees in our area died several years ago, I wondered why. I did research on probable causes and became interested in acid rain. I purchased a hand held pH meter and a water test kit.

I did simulated acid rain studies on mosquito wigglers, tadpoles, shinners, goldfish, and protozoan to find the pH levels when life ceased. I studied plants to determine the leaching abilities of acid rain and the long term effect. I tested the air for dry particles and mineral content. I discovered a big difference in mosquito wigglers and pupa to acid sensitivity. The pupa could withstand a 2.75 pH while the wigglers had long ceased to exist. The goldfish, shinners, and tadpoles ceased at 5.4 pH, which is consistant with other studies. The protozoans died in pH of 6.

My soil tests showed acid causes leaching of ammonia nitrogen, iron, nitrates, and phosphates. The studies show my area to be relative free of acid rain and its' effects.

THE EFFECTS OF SIMULATED SULFURIC ACID RAIN ON A LOCAL AGROECOSYSTEM

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What is the average precipitation pH near Aitkin, Minnesota? What effects does simulated H_2SO_4 rain have on crops?

Precipitation near Aitkin was tested over eight months, and the average precipitation pH was determined.

Three experiments were conducted to determine the effects of H_2SO_4 rain on major crops of the area. Chief oats, Spring rye, and HK-715 wheat were subjected to three simulated rain pH levels: pH 5.8 (control), pH 4.5, and pH 3.2. In Experiment 1, seeds were placed in petri dishes and treated four times during one week. Experiment 2 was conducted like Experiment 1 except that lime seeds were used and the seeds were soaked in water at their designated pH for one day before being transferred to petri dishes. In Experiment 3, seeds were planted in soil and sprayed five times with H_2SO_4 rain over two weeks.

The following conclusions were made:

1. Acid rain isn't serious near Aitkin.
2. Oat germination wasn't affected by decreasing pH.
3. Average dry mass per shoot depended on experiment procedures used.
4. Total dry mass of oat and wheat shoots decreased with increasing acidity.
5. Average dry mass of roots per plant for oats and wheat were lower at pH 4.5 and 3.2 than the control.
6. Blemishes occurred on oats & rye at pH 3.2 & on wheat at 4.5 & 32.
7. Shoot/root ratio for rye and wheat was altered with increasing acidity.

THE EFFECTS OF VARIOUS POLLUTANTS ON FRESHWATER ENVIRONMENTS AS DETERMINED BY MICROCOMPUTER

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The quality of freshwater directly affects all our lives every day because it is the most precious natural resource on earth and all life depends on it. The primary purpose of this project was to research and develop a microcomputer program to determine the biochemical effects of certain pollutants on freshwater pond environments.

The procedure of this project is divided into 8 major parts: (1) Water samples were aseptically collected from a rural pond. (2) Water test tanks were set up for biochemical tests for pH, chloride, alkalinity, nitrates, phosphates, CO_2, and dissolved O_2. (3) Different amounts of Triox Vegetation Killer, 13-13-13 fertilizer, and Toxaphene were added to these tanks to determine the biochemical effects of the pollutants. (1.0ml, .50ml, and .25ml for each pollutant to 1000 ml of pond water) (4) Biochemical data were collected from the test tanks. (5) A microcomputer program was written in BASIC on the TI99/4A microcomputer to analyze the data. (6) Data were added to the program. (7) Data from program were recorded. (8) Data were analyzed along with data collected earlier.

It was found that different amounts of the pollutants do affect the biochemical data from a pond oriented aquatic system. By determining the effects of the pollutants per given amount of water, the data were entered into the computer for fast and accurate analysis.

If an advanced system of limited aquatic study can be developed with the microcomputer to determine the effects of various pollutants on aquatic systems, then it would greatly reduce time and manual labor required to accomplish these tests.

#CONTROL OF THE BACTERIAL CONTENT OF THE AIR IN ENERGY-EFFICIENT CLASSROOMS

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BACKGROUND: Previous research results indicate that the bacterial content of the air in the energy-efficient school classrooms is approximately 380% more than that in the school classrooms which are built with several large windows in each classroom.
PURPOSE: To determine methods of controlling the bacterial content of the air in the energy-efficient school classrooms.
PROCEDURE: I decided to test five methods of control: (1) negative ion generator with activated charcoal filters, (2) disinfectant spray, (3) clean carpets, (4) room temperature, (5) ventilation-air exchange. Before and during the five test methods, I cultivated bacterial content of the air by exposing Petri dishes, containing nutrient agar, for 15 minutes in various classrooms. I then incubated the exposed classroom Petri dishes at 35° C for 48 hours. After incubation, I counted the number of bacteria falling per square foot per minute during a 15-minute exposure. (Since the Petri dish measures 100mm x 15mm, which is 1/15 of a square foot, the colony count represents the number of bacteria falling per square foot per minute in a 15-minute exposure.) I then graphed the data, showing the "before testing" and the "during testing" bacterial content results.
CONCLUSION: The results indicate that control of the bacterial content of the air can best be attained by using a constant ventilation-air exchange at a room temperature of 72°-75° F.
APPLICATION: With the increase demand for more energy-efficient school buildings, the air content of these classrooms should be monitored and control methods should be used.

#Third Award - General Motors ISEF

DOES CYANOGENESIS AFFECT HERBIVORE PLANT PREFERENCE?

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The objectives of this research were to test the hypothesis that plant cyanogenesis does affect herbivore plant preference. This hypothesis was investigated using the copper ethylacetoacetate/tetrabase test for cyanide levels evolved from plant leaves and in determining the relationship between leaf cyanide content and aphid number. Aphids seemed to prefer young rather than mature leaves in 7 out of 11 species growing in the Bryan/College Station community. In those four species where mature leaves were preferable to aphids, one of the species, Johnson grass, had a high cyanide content in the young leaves. Of four species determined to be cyanogenic, Nandina had the highest HCN levels. High HCN content in Nandina leaves was correlated with low aphid survival. The high cyanoclycoside content in Nandina leaves is related to its distribution throughout the leaf mesophyll and not to its high concentrations in epidermal cells. It was concluded that aphids mechanically macerate the leaf tissue, causing an enzymatic breakdown of the cyanoglycoside and releasing HCN. These results suggest that cyanogenesis does affect herbivore plant preference.

THE STUDY OF THE EFFECTS OF FORMALDEHYDE ON DROSOPHILA MELANOGASTER

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The purpose of my research is to determine if formaldehyde causes mutations to occur in Drosophila. Phase I of my investigation consisted of lethal tests. Phase II consisted of identifying visible mutations caused by varying concentrations of formaldehyde. The lethal test consisted of testing varying concentrations of formaldehyde. The different concentrations used were 40%,20%,10%,4%, and 2.5%. The various concentrations were soaked in absorbant cotton and the soaked cotton was placed in a vial. Five flies were placed in each experimental vial. A control group with no formaldehyde was also established. Observations of the time the flies in a certain concentration began to die and the time the last fly died were recorded. Phase II consisted of mixing an equal measure of a concentration of formaldehyde(2.5%,1%,.1%, and .01%) with an equal measure of medium. Attached-X females(5) and ff$-_2$(wildtype,normal) males(2) were put in each experimental vial. A control group was also established. The pupa stages and F_1 were observed.

From the observations of the lethal test I concluded that the death interval is inversely proportional to the concentration of formaldehyde. In other words, as the concentration increased, the time the flies live decreases. I applied this data to Phase II of my project. In Phase II I noted that when the experimental vials are compared to the control vial, a decrease in the number of F_1 is seen. The pupa stages did not develop beyond the level of the medium. The development is 2 to 3 days behind the control group. I also noted that the experimental flies were slightly darker in body color when compared to the control flies.

Comparative Study of Phytoplankton Abundance in Narragansett Bay, Rhode Island and the Phytoplankton Composition of Bahia Fosforescente, a Tropical Marine Environment in Puerto Rico

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During the summer of 1982 the first stage of the study was started at Narragansett Bay, Rhode Island. The purpose of the study was to identify common species of phytoplankton and determine its abundance. During the academic year 1 982-83 the second stage started. It compared the abundance of phytoplankton of the template estuary with the composition of phytoplankton in the Fosforescent Bay, a tropical marine environment in Lajas, Puerto Rico. The area under study was visited twice, in the fall season (October) and the early spring (March). The samples were collected using a nylon net towed by a boat for 15 minutes from the center of the bay and the north-east canal. The analysis of the samples was done using twenty replicates. The results of the research were that the diatoms were more abundant in the center of the Fosforescent Bay during the rainfall season and during the summer in Narragansett Bay; the dinoflagellates were more abundant during the dry season in the Fosforescent Bay than the diatoms. The areas sampled were a very important variant in regard to the composition of the phytoplankton.

#METHODS OF DISPERSAL OF FRESHWATER INVERTEBRATE FAUNA AND FLORA--80-83

Bersi, Robert J.; Springdale High School, Springdale,Ark.
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I will begin with a quote from Robert W. Pennak, Ph.D in his book "Freshwater Invertebrates of the United States," released by The Ronald Press Company. It states as follows:

"In the United States comprehensive studies of fresh-water invertebrates zoogeography, dispersal, and distribution are largely lacking, with the notable exception of the mollusks, decapods, and perhaps one or two other groups."

My project was designed to discover some of the various means in which the phyto and zooplankton are dispersed from an active body of water to an inactive body of water. A quick glance at the procedure will reveal that the collected samples from the wind "traps", bird feces, American Coot, and soil samples were acquired in a manner that eliminates outside factors which could alter the results. Over a period of more than two years the samples were collected and observed, and several biotic species were discovered in the water samples. Chart number four in the report reveals the species found in each separate collection. It is therefore, highly probable that these species were dispersed in the manners tested for.

A brief conclusion for this report would read as follows:
(A) The most efficient means of dispersal was found to be in and on the feathers of the American Coot. (B) Wind dispersal is limited to spore producing Algae. (C) Soil samples contained protist and others that produce cysts. (D) Limited bird feces study indicates primarily plant dispersal.

#Honorable Mention - Robert Bersi

THE EFFECTS OF AMBIENT TEMPERATURES ON SEWAGE LAGOONS IN NORTHERN LATITUDES

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59722
84 East Side Road, Deer Lodge, MT 59722

The sewage lagoon in Deer Lodge, Montana was sampled with a variety of tests to prove that ambiant temperatures in Northern Latitudes cause sewage lagoons to work below their full capacity during winter months.

All tests conducted proved that sewage lagoons are not working as effectively during those months. The tests were taken each week for six months. The tests taken were: Oxygen, BOD_5, Nitrogen, Ph, and ambient temperatures. All tests, excluding temperature, were taken with a Hach Kit.

With the coming of cooler temperatures, the BOD_5 dropped 220 miligrams per liter. The Oxygen dropped 5 miligrams per liter. Nitrogen went up .8 parts per million, and Ph went up .2.

If this study was perfomed again, additional tests to strengthen the results would be Coliform, Phosphate, and Sedimentary Load.

These tests show that sewage is flowing out of the lagoons not fully treated.

It is concluded that lagoons are inefficient during winter months. This suggests that secondary treatment plants should be considered in place of sewage lagoons at those latitudes which have sub-zero temperatures during winter months.

#BIOLOGICAL METHODS FOR WASTE PURIFICATION WITH APPLICATION TO CLOSED WATER ECOSYSTEMS AND SPACE VEHICLES.

ALSUP, DANIEL D., WEBER HIGH SCHOOL, OGDEN UTAH, 84404
810E. 2750N., No OGDEN UTAH, 84404

The purpose of this research is to find a biological method for clarifying organic waste.

I used copepods to break down and clarify waste in test situations. The tests were made in 400 ml beakers filled with 250 ml of waste and waste water. Then approximately 30 copepods were added to each beaker. The tests used were: visual, chemical, bacteria, and coliform. The visual and chemical tests showed conclusive improvements. The coliform tests showed that the water after the copepod treatment was still contaminated.

This lead to phase 2, where I used copepods in conjunction with a natural filter. I added 250 ml of waste and extracted 250 ml of filtered water daily. The filtered water was both visually and chemically clean, and there were only 2 coliform colonies on the ondo agar culture. This showed a reduced and safe contamination level *according to state regulations*. Then after chlorination no coliform colonies would develop.

FUTURE APPLICATIONS ARE:

APPLICATION 1- To develop a closed water ecosystem, using copepods in conjunction with a light weight organic filter, to purify organic waste on a space vehicle.

APPLICATION 2- To develop a closed water ecosystem, using copepods in conjunction with a natural filter, for a lunar space station's waste disposal and treatment.

#Fourth Award - General Motors ISEF

AN ENVIRONMENTAL STUDY OF THE BRINE-SHRIMP *ARTEMIA SALINA* IN PUERTO RICO, WITH EMPHASIS ON THE EFFECTS OF DIFFERENT CHEMICAL SUBSTANCES ON ITS HATCHING ABILITY

Martínez, Milton, Lola R. de Tio H.S., San Germán, P. R. 00753;
Rep. Universidad Calle 12 C-17, San Germán, P. R. 00753.

The purpose of this investigation is to see the effects of different chemical substances on its hatching ability and the effects of environmental conditions on *Artemia salina*. To carry out the different phases of this investigation it was necessary to obtain eggs, sea salt and large quantities of live organisms. Average measurements were determined for both males and females. Preference of light and dark as well as velocity of both sexes were determined. Eggs were cultured in a salinity of 66% and allowed to reached maturity in 10 days under constant light and aeration. All larval stages were drawn and photographed.

The degree of hatching was determined when the eggs are exposed to different chemical salts. An approximately equal number of eggs were exposed to solutions of such salts as lead acetate, strontium nitrate, ferric chloride, sodium biphosphate, potassium nitrate and mercury bichloride in sea water at a salinity of 66%. The number of *Artemias* hatching were recorded per day.

The effect of soaking for ten days on organic solvents such as chloroform, xylol, acetone, butanol, benzene, ethyl acetate, methanol, ethanol, toluene and cellosolve on the hatching ability of *Artemia* eggs was also determined.

THE EFFECTS OF LONG-TERM ULTRAVIOLET RADIATION ON THE PORCELLIO

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Concern over the possible effects of atmospheric pollution upon the ozone layer, allowing increasing amounts of ultraviolet radiation to reach the earth's surface, together with concern over the use of ultraviolet rays in suntan booths led to the formulation of this experiment to examine the effects of ultraviolet radiation on a living organism. The Porcellio was chosen, not only because it is easily located and collected, but also because, like humans, it is sheltered from natural ultraviolet radiation much of the time.

Six populations of ten specimens each were collected. Three specimens were randomly chosen from each population and tested as to their reactions to light, sound, and heat, and also their performance in a simple maze was observed. This series of tests was conducted before and after exposure to the ultraviolet radiation, produced by an ultraviolet germicidal lamp. One population was the control group and was not exposed, while the remaining populations were exposed each day for a period of seven days.

After examining the data collected, no significant changes were observed in performance in the light, heat, or sound tests, nor were there any apparent physical changes. However, there were definite increases in the times required for the specimens in the exposed populations to traverse the maze, and they seemed to be confused and disoriented. While the effects of ultraviolet radiation upon the skin of humans are well known in regard to suntan, sunburn, and skin cancer, this experiment indicates that such radiation may affect a living organism in some manner that is detrimental to certain mental processes, the nature of which is beyond the scope of this project.

#STUDY OF THE NARCOTIC PROPERTIES OF CANELLA WINTERANA AND ITS EFFECTS ON DIFFERENT AQUATIC ORGANISMS

Montes, Yarisa, CROEM High School, Mayaguez, P. R. 00708;
Calle 2 F-5 Urb. Santa Rita, Vega Alta, P. R. 00762.

In the tickness zone of the South Coast line and in the limestone of the Island of Puerto Rico, a shrub, commonly known as "barbasco" and whose scientific name is Canella winterana, can be found.

All parts of this shrub expel a fragant scent with narcotic properties. For years various uses have been given to it and one of these has been to capture fishes.

The purpose of this investigation is to try to determine the compound that exercises the narcotic effect on fish. Various technics, such as thin layer and column chromatography and ultraviolet spectroscopy have been used.

To carry out this study four species of fish were selected; Barbus conchionus, Carassius auratus, Tilapia mossambica and Xiphophorus helleris brevis. Large amounts of the plant were collected, and different concentrations were used with the fishes. This was followed by the attempt to separate the narcotic compound. A previous identification of the compound was made by colors and the Rf of the samples. Other chromatography technics will be used to complete the identification of the compound.

Different environmental studies were made to determine its effects on other organisms and no evidence of lethal effects were found.

#Third Award - General Motors ISEF

THE EFFECTS OF 2-METHOXY-3,6-DICHLOROBENZOIC ACID ON A THERIDIID'S ABILITY TO CAPTURE PREY

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The objective of this experiment is to see if a selective herbicide, 2-methoxy-3,6-dichlorobenzoic acid (Banvel), causes an effect when sprayed on helpful organisms in the field, namely, spiders. The effect to look for is a difference in the spiders' rates for capturing a flying insect, and also to compare activeness and general habits.

Ten Theridiidae (comb-footed spiders) were observed for 4 months and their average rates for capturing an insect was found to be about 40 minutes. The spiders' prey was also sprayed to see if ingesting treated prey had an effect on the spider. Hourly observations were made to record the spiders' rates and habits after application. The various applications were mixed in two rates equivalent to those of a farmer's. They were 1/4 and 3/4 pint of Banvel diluted with 30-40 gallons of water per treated acre. The second application was 3 pt./A.

Because of the overall slower reaction time, a conclusion was drawn that the herbicide,Banvel,has a harmful effect on the spiders' abilities to capture prey. The lower, average rates were not lethal, but with the stronger rate two spiders died. A few spiders were observed as to moving in the opposite direction of the vibrations caused by an ensnared insect. The rates of the spiders eventually returned to normal, so prolonged effects were not determined. The rates for the spiders, treated and untreated, were considerably faster when their prey was treated with Banvel.

Future plans include finding out if the spiders will build up a tolerance to the chemical Banvel, and also experimenting with the next generation.

EFFECTS OF CAR EXHAUST ON RADISH PLANTS

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This experiment is to investigate the Effects of Car Exhaust on Radish-plants. The car exhaust, which composes 27% of all air pollution, represents the primary air pollution that most cities in the world face. Radishes are typical green plants. Generalizations can be drawn from the results.

My hypothesis is that car exhaust will inhibit plant growth.

The same variety radishes were grown for two weeks. They were sealed in two identical aquariums. One was exposed to 100 litres of car exhaust twice daily for a week. The other was exposed to "normal" air. A ruler was placed in each container and the height of the plants was observed daily. The leaf tissues of the different groups of plants was examined microscopically at the end of one week.

The experimental plants' growth was greatly less and the cells were swollen with black streaks and dots in the cytoplasim. They also began to show stress and die on the fifth day. By the seventh day all the exhaust plants were dead.

It is concluded that automobile exhaust kills radish plants.

SUCCESSIONAL CHANGES OCCURRING IN VARIOUS NUTRIENT MEDIA

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How does succession occur in a closed system? Succession is a natural development of a community of organisms over a period of time. The development of the community undergoes a continuous change from an unstable state to a stable or climax condition. It may occur in an area where life does not already exist-such as the effects of a glacier, volcanic activity, landslides, etc. called primary succession. Or it may occur when any community is disrupted by some physical or biological force, but life is not totally destroyed - called secondary succession.

My project deals with a combination of primary and secondary succession conditions. I used a dried soil sample collected from a pond on my farm and placed equal amounts in two one gallon jars with Bristol's solution in one and Knop's media in the other. Once a week, the samples were tested for CO_2, O_2, Ca, Mg, NO_3^-, PO_4^{-3}, total hardness, nitrogen, and ammonia nitrogen with LaMotte's water chemistry kits. Samples were taken off the top, sides, bottom, and the liquid of the cultures and examined microscopically for algae, protozoans, and crustaceans.

The correlation between the water chemistry and organisms followed a predicted hypothesis as the appearance of bacteria as pioneers, unicellular algae, algae eaters, ciliates, flagellates, and finally the more complex forms. Oxygen and carbon dioxide showed a dramatic change along with the phosphates and nitrates during the course of the experiment in population numbers and types of algae and protozoan relationships. In conclusion, my study did not show a climax succession as more changes were still taking place. But the initial successive changes showed a dramatic variety of organisms appearing and disappearing.

FORMALDEHYDE "THE GROWING THREAT"

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This experiment was done to prove whether or not the use of more formaldehyde related products increased the level of formaldehyde in the air of homes. I went around to houses of varying ages and tested the levels of formaldehyde in the air to determine if the newer homes (with more formaldehyde related products) have a greater concentration of free formaldehyde in the air. My hypothesis was: I think that the newer homes will have a great deal more formaldehyde in the air than older homes.

With the ever increasing use of formaldehyde in household products such as plastics; paints, varnishes, and disinfectants, I felt that the levels of formaldehyde would become dangerously high. I hope that with my study into formaldehyde people will become more aware of the dangers of formaldehyde in their homes.

Over all I tested nine homes and asked the following questions to help me understand why the level of formaldehyde was what it was: "How old is your house?", "How many times has your house been remodeled (such as the adding of insulation, painting, addition of a new room)?", "How many cubic feet does your house contain (not including the basement unless it has been finished, at no time was the attic included)?" Conclusion: I found that the levels of formaldehyde in newer homes was for the most part higher than that of older homes.

Further research is needed to prove without a doubt that the levels of formaldehyde is in proportion to the age and the number of times the house has been remodeled.

#THE ECOLOGICAL EFFECTS OF AUTOMOBILE RELATED POLLUTANTS ON SPECIFIC FRESH WATER ORGANISMS--PHASE III

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This is the third phase of a study of the effects of automobile related pollutants on freshwater organisms. Three types of green algae, two types of invertebrates (protozoa and crustacean) and three types of vascular plants (Monocotyledons and Dicotyledons) were used.

Organisms used were Scenedesmus Quadricauda, Chlamydomonas, Euglena Acus, Paramecium Caudatum, Daphnia, Scarlet Hygrophillia, Green Hygrophillia, and Sandriana.

Six sets of experiments were conducted under constant conditions. Varied concentrations of contaminates were introduced to measured samples of each organism and a control kept on each. Population, temperature and bio-mass readings were made each 24 hours for a period of 288 hours.

Visual and microscopic data was gathered and recorded daily. Temperature and lighting were kept constant. Daily records were tabulated in lab notes, charts, and graphs.

The conclusion from data gathered was that all organisms were either stimulated or depressed to some extent by the applied pollutants.

Comparison was made between Phases I, II, and III to find differences, if any, in the pollutants' effects. The effects on added organisms were compared to the effects of these pollutants on green algae.

#Fourth Award - General Motors ISEF
Alternate Award - U.S. Department of Energy

A STUDY OF SOUTH NOLAN CREEK

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South Nolan Creek is a waterway running through much of Killeen, Texas. Beginning in a suburban area and continuing downtown, this creek encounters differing conditions which affect its chemical content. Thus, this project's purpose is to determine water conditions--alkalinity, calcium hardness, pH, and turbidity--and the extent of inorganic chemicals--ammonia, CO_2, chlorides, chlorine (free and combined), dissolved O_2, fluorides, iodides, nitrates, nitrites, phosphates, and silica--as the creek flows along its course.

Procedures used consisted mainly of colorimetric analyses, in which various chemicals were added to the sample to form a colored solution, the intensity of which is dependent upon the amount of solute present. A light in a pre-calibrated colorimeter was then directed through the test sample. Readings on the amount of light passing through were next referred to a chart to determine concentrations.

Upon completion, the following results were determined. Ammonia, turbidity, and those substances associated with the soil were found in greater concentrations in suburban areas. With this knowledge, it is concluded that man and his society significantly influence the chemical content of natural waters, probably by depleting and adding various substances. Further study and research are needed to determine the effects on man and the environment these changes have incurred.

CHEMISTRY

CRYSTALLOGRAPHY - PHYSICAL TRENDS

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Crystallography is concerned with the nature of atomic and molecular arrangements within a crystal, the bonding of the atoms or molecules, and the physical and chemical properties that result from certain arrangements. It is also concerned with atomic arrangements in amorphous materials such as glass.

This project deals with the basic classification of some inorganic crystals, their formations and the physical trends exhibited within the six basic crystalline forms.

Crystals were grown by the evaporation method and by the sealed-jar (supercooling) method. Information is provided on their different formations, the processes used in their growth, and the effects on their shape due to varying conditions.

A literature search was done through the DIALOG Information Retrieval Service. The Chemical Abstracts, Georef and the Physics Abstracts were searched for general trend studies within the basic crystalline types.

A data base composed of numerous physical properties of about 200 chemicals in our stockroom was sorted in various combinations in search of physical trends within the six basic crystalline forms.

Included in this display is a computer "slideshow" of crystalline forms that were drawn on a graphics tablet.

CAN SILVER BE RECOVERED FROM FILM FIXER USING THE ELECTROLYTIC PLATING METHOD?

SAMUEL LENZY KING, IV
LEXINGTON HIGH SCHOOL
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The purpose of this project is to show if it is possible to recover silver from photographic film fixer using the electrolytic plating method. This method involves passing an electric current through the film fixer after it has been used in the developing process of any commercial film. Two positively and negatively charged stainless steel plates submersed in the fixer provide the current flow. The metallic silver collects on the negatively charged plate while the positively charged plate decomposes and replaces the silver in the solution. The silver recovered is approximately 90% pure and is refined when melted down to .999+% fine silver and stamped into troy ounce medallions.

I made and operated a machine capable of doing the electrolytic plating method at a fraction of the commercial cost. By experimenting with the voltage and amperage traveling through the fixer I was able to find-tune the process into one which produces a higher silver yield at a higher purity than the average or above-average commercial processor.

CHEMICAL PROPERTIES OF NASUNIN

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2-98-100, Mamezukacho, Sakai, Osaka, Japan Zip 591

The vegetable fruits of the egg-plant is not only a popular and useful vegetable food in Japan. But is also noted for the beautiful dark purple color of its epidermis. This color consists of anthocyanin, called NASUNIN (NASU is the Japanese name of egg-plant). This anthocyanin was first isolated in a crystalline form and identified by a female Japanese Chemist Prof. Kuroda in 1933. When the egg-plant is pickled with salt, sometimes its beautiful dark purple color turns into a dark brown color. In searching for the reason I first isolated the pigment from the egg-plant by using gel-chromatographic techniques. It became obvious that the gained pigment consisted of delphinidin as an aglucone, glucose and rhamnose as a sugar component and p-coumric acid component. When the egg-plant is salted, lactic acid is formed as a second product. Decreasing pH by yielding of the acid, Nasunin changes into a colorless pseudo-base. I certified this by experiments and considered the results correlating with the fading phenomena of pickled egg-plant. On the otherhand, the egg-plant contains many kinds of enzymes. Certain enzyme act to decompose the anthocyanis I studied how this enzyme decompose the anthocyanin and how the decomposition reaction occurs. As it is well known, aluminum ion or ferrous ion can act as preservative against discoloration of the anthocyanin, holding its beautiful color. This is the reason why Nasunin is formed into complex compounds with metallic ions, it resists to yield its pseudo-base formation or to decompose with enzymes.

#THE MANIPULATION OF AN OSCILLATING CHEMICAL SYSTEM

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The purpose of this research is to study various aspects of an oscillating chemical system which have not yet been studied. An oscillating chemical system is a solution in a closed system which undergoes color changes after it has seemingly reached equilibrium. Although there has been limited research of oscillations, there is evidence that the reaction does not violate the second law of thermodynamics. Since oscillating color changes are caused by the self-varying concentrations of one or more of the reactants, the initial concentrations of the reactants would seem to be the most important factor in determining whether or not a system will oscillate. However, it has been reported that specific concentrations are not consequential. The major part of my research tests that statement.

Early experiments were conducted by varying the temperature of the system and keeping it constant while timing the color changes. Further experiments include spectroanalysis to determine how color itself is affected by different concentrations. Another method of experimentation involves use of two platinum electrodes which measure the relative change in the energy as the iron(II) oxidizes to iron(III)

Further experimentation may involve testing to see if the ratio of surface area to volume affects the system's behavior. Also, the different physical phenomena occuring in the oscillation will be studied when the solution is within containers of varying shapes and sizes.

#Honorable Mention - Eastman Kodak Company

#EFFECTS OF ANNEALING BENEATH TG ON THE STRUCTURAL AND MECHANICAL PROPERTIES OF POLYVINYL CHLORIDE

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Thermal treatment of polyvinyl chloride (PVC), a common commerical plastic, influences the physical and structural properties of the polymer. This study was carried out as an investigation of the relationship between prior history of PVC and its mechanical and structural properties. Furthermore, the determination of a correlation between alterations in free volume and the effects of varied thermal treatment was investigated.

Annealing temperature and time were varied. PVC was obtained as clear sheets and was subjected to thermal treatment below its glass transiton temperature (Tg). Samples were then annealed at 55, 65, 75, and 85°C for 1, 3.16, 10, 31.6, 100, and 316 hours.

Density of the annealed PVC, determined by a density gradient column, increased by as much as 10.5%. As predicted, annealing temperature had a greater effect on the density of PVC than annealing time. Differential scanning calorimetry (DSC) results revealed a great amount of enthalpy relaxations occuring in the 55 and 65°C samples. The extent of this reduction, as shown by the endothermal peak at Tg, increased as a function of time. The scans of 75° samples indicated that a different mechanism, possibly the alteration of the internal coupling of molecules, occurred in this region. At 85° the peak appeared only after one hour of annealing. Another new mechanism, the return of the material to the true state of equilibrium, occurred in this region during longer annealing periods. The absence of any alterations in crystallinity was confirmed by X-ray diffraction analysis.

#Fourth Award - General Motors ISEF
Honorable Mention - American Chemical Society

DECOMPOSITION OF DICHLOROACETIC ACID IN PHARMACEUTICAL PREPARATIONS

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Lactic Acidosis is the result of a rise in blood lactate level, a fall in the bicarbonate content of the plasma, and almost always a dangerously low blood pH. It is often fetal for leukemic, cardiac, diabetic and traumatized patients. A chemical compound, dichloroacetic acid (DCA), is thought to be an alternative to the traditional treatment which involves the administration of bicarbonate.

This research was aimed at determining which levels of temperature and pH would decompose DCA so that these conditions could be avoided in its preparations and storage.

DCA was surprisingly stable in pharmaceutical preparations. All of the concentrations of the experimental samples were almost the same as those of the controls. No decomposition was noticed at 100°C, nor was decomposition noticed at pH values from .1 to 14. It remained unaffected by all conditions designed to force decomposition. It can be derived from these results that the present preparation and storage techniques are acceptable with respect to DCA's stability.

Some future research might include resistance to moisture, radiation, and light. The reason that I did this particular research was because I was involved in a science training Governor's school, and this was of the choices presented to me.

NEW PERIODIC CHART

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By combining the Mendeleev Periodic Chart and the Electron Configuration Chart in a spiral shape, the importances and relationship of all elements are more visualized. It also brings all elements, including the rare earth elements in a unified sequence.

A STUDY OF THE PHOTOCHROMIC AND PIEZOCHROMIC DIMERS OF THE TRIPHENYLIMIDAZYL RADICAL

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This experiment is truly a concatenated one in that an extensive range of techniques and theories from both physical and organic chemistry have been conjoined to investigate the problem.

The remarkable Triphenylimidazyl Radical was formed upon the dissolution of the dimeric precursor in organic solvents. Recombination of the radicals occured over a period of minutes at room temperature. However, the resulting dimeric compound could be broken up into the radicals by the action of light. This reaction showed a dramatic and rapid color change from pale yellow to purple. Furthermore, this photolysis-recombination cycle could be run almost indefinitely. This was extremely useful during the investigation of the order of reaction, activation energy, and the extinction coefficient. After getting values for these characterisitics I was able to understand what happened during this complicated reaction and why it exhibited the rare phenomenon of photochromism. I was also able to conclude that the Triphenylimidazyl Radical was indeed a "free" radical.

A COMPARATIVE QUALITATIVE STUDY OF PAPER PROCESSED FROM THE RINDS AND PULPS OF THREE CITRUS FRUITS

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The purpose of this experiment is to find out if paper can be made from orange, grapefruit, and lemon rinds and pulps. If so, can it be considered quality paper? And each being processed by three methods, are they good writing surfaces? In processing these sheets, the early Egyptian Method, the Rag Method, and the Modern Method, that we used today to make paper with wood were used. From observations obtained through experimentation, it was found that writing surfaces can be produced, but not from all types of sheets produced by each method. With further experimentation, these writing surfaces may become actual sheets of paper. This experiment, investigated further, may prove to be useful to our society and economy because if paper can be processed from these raw materials the cost of the production of paper and its sale would not be as expensive as that produced from wood, and other hard to obtain raw materials.

#The Synthesis of Heteroaromaticimidazoles: New Chemotherapeutic Agents in the Fight Against Filariasis

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A novel method for synthesizing noth aromatic and heteroaromatic imidazole carbamates has been formulated, verified and the experimental conditions optimized for a number of specific compounds. Carbonylmethoxyisothiocyanate has been used to introduce at one and the same time the carbamate functional group and a function that permits the facile cyclization of 1,2-diaminobenzenes and 4,5-diaminopyrimidines into the corresponding benzimidazole and imidazopyrimidine carbamates. The cyclization is accomplished by means of a cyclodesulfurization reaction in which dicyclohexlxarbodiimide abstracts a sulfur from the thiocarbonyl function which undergoes nucleophilic attack by the amine to form the imidazole moiety. This is the first time that either these reagents or reaction sequence have been employed in the synthesis of these two important classes of carbamates. This synthesis method permits the preparation of systematic suites of large numbers of compounds similar to mebendazole--a broad spectrum anthelminthic which holds considerable promise as an antifilarial agent. The imidazopyrimidine carbamates are presented here as a new class of possible filariacides and have been synthesized in anticipation of an antifilarial activity exceeding even that of benzimidazole carbamates. Previously developed methods for synthesizing benzimidazoles could not be used to synthesize imidazopyrimidine carbamates.

It is hoped that the compounds synthesized will lead to improvements in the treatment of filariasis for which there have been almost no advances in treatment for over 35 years and which cripples with increasing incidence the economies and hundreds of millions of inhabitants in the poorest nations of the world.

#First Award - General Motors ISEF
First Award - United States Army
Third Award - American Patent Law Association

A GAS CHROMATOGRAPHIC STUDY OF ESTERIFICATION KINETICS

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The purpose of this project was to react various primary alcohols with acetic acid in the esterification process and to see if any correlation exists between the chain length and reactivity rates of the alcohols. Equimolar amounts of alcohol and acid were reacted in a thermostated water bath. Samples were removed periodically and were injected into a Gas Chromatograph for analysis. After the reactions reached equilibrium, the data were graphed by plotting time versus percent ester. It was hypothesized that the reaction rate would continually decrease as the chain length of the alcohol grew, but it was apparent from the graph that this is not the case. For methanol, ethanol and n-propanol the reaction rate decreased as the chain length increased, but for n-butanol and n-pentanol, the reaction rate increased with increasing chain length. The data were then graphed using equations for both first and second order reactions. From these graphs it was apparent that two different mechanisms are involved in esterification. Methanol and ethanol follow second order kinetics as indicated by thier straight line graphs with the second order equation. n-Butanol and n-pentanol were seen to follow first order kinetics. n-Propanol produced a straight line graph with neither equation. From these data it is evident that a transfer of mechanisms occurs, and that n-propanol is the crossover point.

#INVESTIGATING THE INTERACTION OF ATRAZINE AND TRAZCO B*401: A TOXICOLOGICAL AND METABOLICAL STUDY

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Trazco B*401, a bacterial-fungal complex containing selected soil microorganisms, was tested through the third phase of this research to determine whether its interaction with atrazine, a corn herbicide, contributes any harmful effects to the environment. Also investigated was the substances produced during the decomposition process.

To conduct the first part, two different toxicity tests were performed: soil tests and contact tests. For the soil tests, ten soil patches were made. Three each were treated with various doses of atrazine, B*401, and combination of both, with one patch as a control. Worms were exposed to samples removed from each patch every four weeks. Three analyses were conducted in the tests: mortality, weight, & oxygen.

For the contact tests, seven different dose solutions of atrazine, B*401, and combination of both, along with a control solution were made. Every three weeks worms were exposed to small amounts of each solution and analyzed after two and four days for signs of death.

The second part involved making agar cultures of atrazine, B*401, combination of both, and controls. Every three weeks eight cultures were extracted and tested with TLC to determine the presence of atrazine and its metabolites.

The results indicate that although the atrazine-B*401 combination produces some harmful effects to the environment during the first two months, it is actually the atrazine, already known to be toxic, which causes the harm rather than the B*401's decomposition process since no major decomposition occurs during that period of time.(After nine weeks $Cl/NH_2/Ipa$ and OH-atrazine are produced. After twelve weeks there is presence of $OH/NH_2/Ipa$.) Furthermore, the B*401's use is harmless.

#Second Award - General Motors ISEF
Fourth Award - American Chemical Society

#OPTIMIZATION OF A CHEMILUMINESCENT DETECTOR FOR ARSINE

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Chemiluminescence is intrinsically a sensitive technique for the measurement of trace gases. The major requirement is a reaction which results in light emission. Intense light emission has been demonstrated when analyzing arsine by chemiluminescence with ozone at concentrations of a few parts per million; but at lower concentrations there is a nonlinear decrease in intensity. This was attributed to a slow initial reaction between arsine and ozone followed by faster steps which emit light. In order to correct this non-linearity, the fast reaction of hydroxyl radicals with arsine was attempted as the initiation step. Various methods of radical generation and introduction were attempted.

The optimum operating conditions discovered use a reactor pressure of 310 Torr, and the radicals are produced by passing a stream of oxygen through a 30% hydrogen peroxide solution and then through a discharge ozonizer maintained at reactor pressure. This condition results in linear detection of arsine over 5 orders of magnitude and an estimated detection limit of 200 parts per trillion.

#Second Award - United States Navy
Third Award - American Chemical Society
Third Award - General Motors ISEF
Honorable Mention - American Patent Law Association

#COAL HYDROGENERATION: THE TEST AGAINST GASOHOL

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PURPOSE: The purpose of this project is to compare the results in an extensive road test conducted using ethanol mixed gasohol and coal derived gasoline produced by the experimenter and unleaded gasoline. The structures of each fuel was determined using various chemical analysis tests.

PROCEDURE: Alcohol was produced from corn and sorguhm and fractionally distilled. Approximately 30 gallons were produced using the above process. Thirty-seven gallons of commercially produced gasoline were purchased. Of this amount, 15 gallons were mixed per 5 gallons of alcohol to produce the test mixture. Thirty-two gallons were used in the control car. A rotating autoclave designed by the experimenter, to convert coal into conventional fuel was used to produce 100 gallons of solvent refined coal. The above fuels were used in the road and mileage tests.

CONCLUSION: Data collected indicated that gasohol proved to be the most efficient fuel. It was also determined that coal derived gas (CDG) and coal derived fuel oil were most inexpensive to use when one considers availability, chemical structure and cost. The rotating autoclave constructed by the experimenter was able to produce a solvent refined coal and could be used to repeat this process on a larger scale inexpensively.

#First Award - Gulf Oil Corporation
First Award - U.S. Department of Energy
Second Award - General Motors ISEF

PALM TREE OIL (Elais melanococa)
"Typical Panamanian name: Corocita"
A Sourse of Energy

Ascanio González, Instituto Urracá, Veraguas
República of Panamá

OBJECTIVE: To demostrate that the oil extracted from a species of palm tree called "corocita" can be itilized as a substitute on as a complement of kerosene, which is used as a source of energy in remote areas.
"Corocita" (Elais Melanococa) is a palm tree that produced an oval shaped fruit containing from 40 to 50% of oil in its pulp.
To obtain oil from this fruit follow this process:
1. Press the fruit and combine with water.
2. Strain this mixture and put to boil.
3. Cover and leave it until next day.
4. By means of decantation get apart the oil and put it to boil again to eliminate water completely.
Wue found that corocita oil has the following characteristics: calorific potential, diffusion capacity, iodine index, saponification index, density
To prove that the "corocita" oil works as a source of energy to produce light we used an ordinary lamp to which we adapted a movable deposit to check up the quantity of oil that went up to the wick.
It was also proved as a source of heat in a stove. To use it we modified the means of feeding the stove.
As a result of these experiments we learned that "corocita" oil can be considered a kind of fuel usable in remote areas. Since the palm tree that produces "corocita" (Elais melanococa) grows easily in tropical areas, the utilization of its oil becomes cheaper than kerosene, alcohol, etc. Its combustion does not produce soot, so it does not increase air polution.

THE DETERMINATION OF THE PRESENCE OF STYRENE IN HOT WATER

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The purpose of this project was to find out if drinking hot liquids (such as cocoa and coffee) from a styrofoam cup is dangerous.

I tested for styrene leaching from stryofoam particles immersed in hot water, using an infrared and ultraviolet spectrometer and a gas chromatograph.

My investigation indicates that a substance did leach out of the styrofoam. The studies so far point to styrene. This conclusion is uncertain, but the potential hazard seems great enough to demand further tests.

#AN OSCILLATING IODINE CLOCK REACTION

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A reaction mixture containing potassium iodate,sulfuric acid, manganese sulfate,malonic acid,hydrogen peroxide,and starch at proper concentrations produces a cyclic change in colors from clear to yellow to blue.This cycle can be repeated several times depending on the concentrations of the reactants.At the same time,the iodide, iodine,and Mn^{+3}/Mn^{+2} concentrations undergo oscillation.In this research,the factors that affect the reaction have been examined along with the individual reactions that make up a proposed mechanism.From these data,a mechanism is proposed to explain the unusual cyclic changes in the colors of the solution.

#Fourth Award - General Motors ISEF

# POST COLUMN REDUCTION USING A ZINC METAL REACTOR IN ELECTROCHEMICAL DETECTION FOR LIQUID CHROMATOGRAPHY

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A new approach to extending electrochemical detection to reducible compounds through the use of a zinc metal post-column reactor before oxidative detection is described. The compound p-benzoquinone was initially tested to demonstrate the detection range under which the system would be quantitative. The results showed that the detection limits were 0.6 picomoles per injection, the response of the detector was linear over four orders of magnitude with a correlation coefficient value of 0.999, and the chromatography was essentially unaffected by the dead volume of the reactor. Further work showed that compounds of importance such as the vitamin K analogs menadione and menadione sodium bisulfite produced results comparable to those of p-benzoquinone. Based on the findings of this study, the future looks very promising for this new technique which expands the potential range of compounds that can be detected electrochemically.

#Third Award - General Motors ISEF

#STRUCTURE ELUCIDATION OF ORGANIC COMPOUNDS BY COMPUTERS

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A computer program was developed which would deduce the three dimensional structure of an organic molecule given spectoscopic data and an empirical formula. Compounds have characteristic spectroscopic data relating to their structure. The program uses data derived from IR and UV photospectroscopy, mass spectroscopy, and nuclear magnetic resonance spectroscopy. Each spectrum is analyzed to determine the chemical groups in the compound responsible for the spectral features of the data. Those groups which appear in more than one spectrum are used as building blocks for the molecule. The mass spectrum data is analyzed to find fragments which are arranged to form a sequence from the smallest mass fragment to the complete molecule. The fragment sequence is modified to conform with the chemical group data. The library of previous analyses is then searched for an equivalent data set: i.e., the same empirical formula and data constant with that of the unknown sample. If so, the matching library structure is presented. Otherwise, all structures consistent with the provided data are drawn individually by a tree search method. If more than one structure is consistent with the provided data, after the structures are presented, additional data is requested. If further data is introduced, the system is reanalyzed and the surviving structure(s) drawn. Alternatively, at this stage the operator can directly identify the structure. The data set and the structure(s) derived are then stored in the library for use in future analyses.

#First Award - Atari, Inc.
Second Award - American Chemical Society

ZINC IN SOIL

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Different metals accumulate in the environment through human use. One of these which concerned me was the zinc from galvanized roofing and siding on buildings. Galvanized roofs and siding on old buildings seemed to show iron rust on them. This meant that the zinc coating was absent and allowed the exposed iron to rust.

Where did the zinc go? If it was washed off the building, did it stay in the soil? If so, how far did it travel from the source?

To answer these questions, I decided to take soil samples from around buildings having galvanized roofs and analyze them for zinc.

The soil samples were weighed, dried, reweighed, and leached with hydrochloric acid. They were then filtered and diluted to a known volume. The samples were analyzed on an atomic absorption spectrophotometer and compared with standard zinc solutions which I prepared. The results show that soil not only contains zinc but also holds it, and its concentration decreases rapidly with distance from the source. These data were statistically compared with the age of the buildings where the samples were obtained.

#HYDROGEN: A POSSIBLE SYNTHETIC FUEL

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The purpose of this experiment was to study theoretical and experimental characteristics of an electrolysis cell, including the efficiency of various types of electrolytes when used for producing hydrogen. In addition, a variety of different mediums for storing hydrogen as a solid in the form of metal hydrides were investigated. In performing the electrolysis section of this experiment, numerous types and concentrations of electrolytes were placed in an electrolysis cell. During each test, electricity was allowed to flow through the cell for a given time period. After discontinuing the current, the amount of hydrogen produced was recorded along with the other pertinent information affecting the test. Using this information, the cell was completely analyzed, and all of the desired quantities could be calculated. As for the storage of hydrogen, various types of metal hydrides were synthesized in a controlled atmosphere chamber where the composition and properties of these compounds were measured. Protecting the various metal hydrides from contamination was the major problem encountered. The results which were extremely good from this experiment showed that a 3.5 molar solution of sulfuric acid was the most efficient medium studied for producing hydrogen. Two equations were developed to accurately describe the processes occurring in the electrolysis cell; also, two alloys, one consisting of 50% titanium, 40% iron, and 10% manganese, the other, consisting of 95% magnesium and 5% nickel, appear to be feasible mediums for hydrogen storage. The cumulative results give rise to the possible use of hydrogen as a synthetic fuel.

#First Award - General Motors ISEF
First Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
First Award - U.S. Department of Energy
First Award - Vacuum Technology Division/American Vacuum Society
Meritorius Award - United States Army

#SURVIVAL OF VITAMIN C IN FOOD PREPARATION

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Spinach and potato mash were subjected to temperatures between 50° C and 120° C for variable time spans. 5 - 6 samples were drawn in 5 minute intervals at a fixed temperature. After addition of 1% oxalic acid the samples have been titrated with 2,6-dichloroindophenol. The ratio of the amount of vitamin C before and after the heat treatment as a function of time has been plotted in a semi-logarithmic plot. A straight line was found for a fixed temperature indicating an exponential decay. The slope of this line gives the rate constant k for one temperature. All data were analyzed to calculate the temperature dependence of k. An Arrhenius plot of ln k versus 1/T provided the activation energy for vitamin C to 8.5 Kcal/Mole. The agreement between spinach and potatoes with the previous results of Paulus[1] show that the decomposition of vitamin C is independent of the food and equilibrium is reached between the vitamin concentration in the sample material and the supporting water. These results allow the determination of the decomposition of vitamin C for any temperature and exposure time.

[1] K. Paulus, Journal of Food Science 44, 1169 (1979)

#Fourth Award - General Motors ISEF
Honorable Mention - American Chemical Society

THE RATE OF DEGRADATION AND THE KINETIC ORDER OF VITAMIN C WHEN EXPOSED TO COPPER

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During the past three years I have conducted experiments with vitamin C. In the two previous years I discovered that vitamin C solutions degrade most rapidly when exposed to copper in powder form. This year's experiment focuses on accurately measuring the rate of vitamin C loss when exposed to copper in powder form, and determining into which kinetic order the degradation of vitamin C fits. My project involves chemical kinetics and the rate constants when vitamin C is exposed to copper powder, oxalic acid, and a combination of copper powder and oxalic acid, maintained in a controlled situation. By titrating I was able to test the amount of vitamin C in the samples at 30 minute intervals. I analyzed this data and determined the following:

1. When copper powder is added to a vitamin C solution, the rate of loss of vitamin C is accelerated.
2. The constants describing the rate of vitamin C loss for the five samples were computed and the results displayed in my exhibit.
3. The loss (oxidation) of vitamin C is determined to be a second order reaction for all tests.
4. When oxalic acid is added to a vitamin C solution the rate of vitamin C loss is slowed.
5. When both copper and oxalic acid are added to a vitamin C solution, the rate of vitamin C loss is faster than when only oxalic acid is added, but slower than the control solution, and much slower than when only copper is added to the vitamin C solution.

OSCILLATING REACTIONS

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INTRODUCTION:

A color ocsillating reaction occurs when malonic acid, hydrogen peroxide, potassium iodate, manganese sulfate, sulfuric acid and starch are mixed in the proper proportion.

PROBLEM:

What organic compounds with structures similar to malonic acid can be substituted for malonic acid in a Briggs-Rauscher oscillating reaction.

HYPOTHESIS:

Compounds with structure similar to malonic acid which have acidic hydrogens adjacent to a carbonyl group will produce a similar oscillating reaction.

EXPERIMENT:

Solutions containing 410 milliliters of 30% H_2O_2 diluted with water to one liter (Solution A) 42.8 grams of KIO_3 and 40 milliliters of H_2SO_4 diluted to one liter (Solution B), and 15.6 grams (0.15M) of malonic acid, 3.38 grams of $MnSO_4H_2O$ and 0.30 grams of starch diluted to one liter (Solution C) were prepared for the oscillating reaction. Other organic compounds were substituted for malonic acid in Solution C.

OBSERVATION:

Succinic acid, malic acid, diethylmalonate, 2,4-pentanedione and ethylacetoacetate were tested each time as substitutes for malonic acid. Only ethylacetoacetate and 2,4-pentanedione produced the oscillating reaction at the concentrations tested.

#CORROSION INHIBITION BY AMINES

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Corrosion is an expensive problem in all nations. It caused approximately $120 billion damage in the USA in 1982. One widely used method of controlling corrosion is the use of corrosion inhibitors. Yet, no useful theory exists for predicting the ability of a compound to inhibit the corrosion of a metal in a particular environment. This research was concerned with examining certain chemical and physical properties of amine inhibitors and relating them to their ability to inhibit the corrosion of low carbon steel in HCl. Weight loss studies were made in acid solutions containing the different inhibitors. Base strength, molecular size, nitrogen availability, and the type of amine were then related to its effectiveness as an inhibitor. The most effective amines: octylamine, quinoline, and CHG were selected for further study. Polarization studies, measurements of the activation energy, the values of ΔG for the reactions, and the adsorption properties of the amines were made and related to their effectiveness as an inhibitor. All amines studied had a definite effect on the corrosion rate, polarization curves, activation energy, and thermodynamics of the corrosion reaction. Of the amines studied, quinoline and CHG were chemisorbed on the corroding surface. A correlation appears to exist between the amines' effectiveness and nitrogen availability, molecular size, the ability to be adsorbed on the metal surface, and the ability to retard either or both the anodic and cathodic reactions.

#First Award - United States Air Force
Third Award - General Motors ISEF

THE USE OF ELODEA AS AN INDICATOR OF CHEMICAL POLLUTION

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PURPOSE:

To determine whether the water plant *Elodea* will be a suitable indicator of trace-metal water pollution.

PROCEDURE:

I set up sixty petri dishes containing different concentrations of Cadmium Chloride, Cadmium Sulfate, Cupric Chloride, Cupric Sulfate, Ferrous Chloride, Ferrous Sulfate, Nickel Chloride, Nickel Sulfate, Zinc Chloride, and Zinc Sulfate, plus control dishes. In the solutions I placed one gram of *Elodea*. The plants were poisoned for seventy-two hours. They were then pulverized in a blender with acetone for ten minutes to extract a uniform amount of pigment from each. The resulting solutions were standardized by adding enough acetone to make fifty millilitres. This solution was then centrifuged to remove plant particles. It was then run through a Spectrometer-20 to determine the percent of light transmitted.

CONCLUSION:

The above-mentioned chemicals all have a detrimental effect on *Elodea*, as is evidenced by its marked decrease in pigment as shown by the resulting increase in percent transmittance. When the results were graphed, the graph of percent transmittance vs. the log of the concentration of the poison is the most linear. Therefore, I can conclude that the percent transmission is directly proportional to the log of the concentration of the poison.

THE FORMATION OF LIESEGANG RINGS

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This project is an attempt to show some of the variations in Liesegang rings when formed under different conditions. Liesegang rings are a phenomena of periodic precipitation. These rings form when a solution containing one compound is added to a gel containing another compound. The solutions react together to produce a precipitate as one compound diffuses into the gel. The precipitation appears as a series of rings with clear areas between them. The clear areas appear because as precipitation occurs the concentration of the ions in the gel is depleted and thus, to continue precipitation, the upper electrolyte must travel further into the gel to where the gel electrolyte is in sufficient quantities to precipitate.

Scientists believe that Liesegang rings may account for the ring formation in agate, fish scales, quartz in limestone, rings in broken icicles, and birds' feathers. Liesegang rings are not formed by all compounds that will precipitate; therefore, experimentation is required.

The gel medium is important. When using silica gels it is necessary to be aware of unwanted chemical reactions forming silica compounds. Agar and gelatin work the best when chemical reactions may cause problems but both have drawbacks. Gelatin has a tendency to break down when exposed to a concentrated chemical and agar has a tendency to dry out and crack.

In conclusion, it was observed that time, composition of the electrolyte, concentration of the exlectrolyte, and composition of the gel are factors which cause variation in the formation of Liesegang rings.

#A STUDY OF THE CHEMICAL AND PHYSICAL ASPECTS OF THE ENVIRONMENT OF ST. JAMES PARISH

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The work on my project is phase I and II of a three year study of the impact of industry of St. James Parish. Phase I concentrates on solid products and phase II concentrates on river water. Research on the solid waste was done using activation analysis and was conducted at the L.S.U. Nuclear Science Center. Activation analysis was chosen for its sensitivity. Elements found to be present in the 2 major products were as follows: 1) Chromium 2) Cadmium 3) Lead 4) Boron 5) Mercury 6) Silver 7) Aluminum 8) Lanthanum 9) Manganese 10) Scandium 11) Calcium 12) Sulfur 13) Phosphorus 14) Florine 15) Radium 16) Cobalt 17) Vanadium. It was found that all industries in the study area had containment systems for the waste materials which were effective and well monitored. Test on streams in the surrounding areas for traces of the waste failed to show any. In phase II of my work I tested the Mississippi River in the parish to determine the level of pollutants present over a year's period of time. In phase II I reached the following results: 1) The BOD mean did not change in the parish 2) Conductivity increased 3) The dissolved oxygen decreased 4) Color changed 5) PH increased 6) Turbidity decreased 7) Temperature increased 8) Arsenic increased 9) Cadmium decreased 10) Chromium increased 11) Copper increased 12) Lead decreased 13) Mercury increased. In conclusion, instream pollution concentrations in the study area are generally below the maximum level stipulated by state and federal laws concerning swimming, fishing, and water supply. However, during the test period, levels of Arsenic and Mercury were high. This should be noted and further study is indicated. Further test on point source show discharge from vessel traffic, spills, and short term discharges to be the major problem.

#Third Award - General Motors ISEF

CHROMATOGRAPHY OF PLANT PIGMENTS

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The purpose of my experiment was to determine the effects of different solvents upon the separation of anthocyanin pigments in rose petals; and chlorophyll, xanthophyll, and carotene pigments in grass, in a chromatographic column.

My method to extract the pigments from the plant material was to add acetone at room temperature and let the mixture stand from 5 to 10 minutes. The next step in the process was to apply the pigments to a 50 x 3 cm glass column packed with granular silica gell. My solvents were cyclohexane, isopropyl acohol, or ethyl alcohol. This carried the pigments through the column where they separated into color bands.

My experiments showed that when cyclohexane was used as a solvent there was adequate separation of the color bands; however, many problems arose during the run and when cleaning the silica gell after the experiments. Ethyl alcohol had blurry separation and it took longer to run through the columns. Isopropyl alcohol showed the best separation overall. The boundaries of the color bands were clearly defined and on the whole, the results were by far superior to those of the other solvents.

My plans for continuing these experiments include trying different solvents to change the order of the pigment bands, trying different conditions and solvents to speed up the separation process, and, collecting fractions and purifying the pigments. A practical application using this method is collecting anthocyanins in order to enhance the color of foods.

THE EXTENSION AND COMPLEXITY OF RADIOACTIVE DECAY

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This project investigates two aspects of radioactive decay. The first aspect involves the complexity of the decay pattern. Since the Rutherford-Geiger paper in 1910, the Poisson distribution has been the accepted model of radioactive decay. I applied the negative binomial distribution and found a better fit to observed values. This means that the decay may be more complex than previously thought. For example, the rate of decay can no longer be viewed as constant but as subject to random variation according to a continuous Gamma distribution. This finding should alter the half-life concept of radioactive elements.

The second part of my project involves hypothetical models of radioactive series. In my investigation of the four known radioactive series, I found numerous regularities for undiscovered elements numbered 114-127. Among these were the identification of stability multiplets for isotopes One of my conjectures predicts that these paraserial elements (114-127) form an unstable radioactive series, in conflict with the Seaborg Model of stability for these elements. Professor Glenn T. Seaborg was kind to tell me, by correspondence, that he agreed that my model was correct. This research should assist in the discovery and analysis of new elements.

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PRELIMINARY TO IONIZATION DISSOCIATION & REDUCTION OF CARBON DIOXIDE

The purpose of this experiment is to devise and construct an apparatus which through electrochemical means will effectively reduce the carbon dioxide molecule to atomic carbon and molecular oxygen or to carbon monoxide and molecular oxygen, which in the latter case would be immediately followed by a system that thermally disproportionates carbon monoxide.

A partially evacuated tube should be filled to a low pressure with carbon dioxide gas, having in it a small piece of sodium metal which would serve as the reducing agent. Very high voltage electrical discharge across the length of the tube would ionize the carbon dioxide gas as well as some of the sodium metal. After ionization has taken place, strongly electropositive sodium cations should react and combine with the oxygen anions, leaving reduced and uncharged carbon atoms and sodium oxide.

Other less probable alternative reactions are also possible in the highly ionized state within the tube: the disproportionation of carbon dioxide into carbon monoxide and oxygen, the formation of the superoxide of sodium. and undesirable reactions of impurities in the sodium metal or the carbon dioxide.

The apparatus was constructed and operated. A potential difference of approximately 50,000 volts was imparted to the tube, induced between simple copper wire anode and cathode terminals. This discharge produced a bright lavender glow between the electrodes, and a bright yellow track across the sodium metal. After fifteen minutes of operation, the observably darker sodium fragments were removed from the tube leading to qualitative results that supported the first postulate.

#THIN LAYER METALLIC CRYSTAL FORMATION WITH RESPECT TO DIRECT CURRENT AND ULTRASONICS

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In the past, the procedure for growing metallic crystals has been complicated and time consuming, making it nearly impossible to study individual differences in crystal structure and formation. The purpose of this project is to grow metallic crystals from a variety of chemical compounds, comparing crystal structure, rate of formation, and final pattern of formation. Variables for observation will be various chemical salts, amount of electric current, and the effect of ultrasonics.

The procedure uses a student-designed viewing cell holding 2 ml of saturated solution. The cell is then exposed to direct electric current and/or ultrasonics and viewed with a microscope. Comparisons are made with controls. Photographs are used to compare and contrast the results.

Three metallic crystal patterns were discovered - ferns, feathers, and straights. A fourth group were too reactive to crystallize. Ultrasonics and increased voltage affected the crystal formations dramatically. The crystals were larger and less distiquishable. The rate of growth was also slowed.

The procedure used in this project allows for testing these crystals with a variety of variables, using microscopic and photographic observations for analysis.

#First Award - Eastman Kodak Company

Toxic Gases From Burning Synthetics

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Problem: Fires claim the lives of many people each year. Most of the deaths are not caused by the flames, but by the smoke and gases that the victims inhale. WHAT ARE THOSE GASES?

Hypothesis: By studying the formulas for various synthetics, I feel that I can predict what kinds of gases will be given off when that synthetic is burned. My research will prove or disprove my predictions and also show which gases are given off.

Methods: First, make the chemicals that will be used in testing for the gases. Next, find all of the synthetics that will be used in the tests. Test each sample twice. Once, in the free air with no restrictions on the amount of air going to the sample, and again with a large beaker over the sample while it burns. This simulates the conditions often found in a structure fire. Write down the results of the test. Take photos of interesting parts of the project. Make a conclusion.

Data: All of the synthetics gave off CO_2 when they burned. In addition to that, other synthetics gave off more dangerous gases including: HCN, S^- (most likely H_2S), NO_2, HCl, SO_2, and NH_3.

Conclusions: All of the synthetic materials that I tested gave off gases that were harmful or fatal to humans. Some were only mildly irritating (CO_2), but some were quickly lethal (HCN). Synthetic materials seem to me, to be very dangerous in places that contain a large amount of people. Especially, in places where there may be a great fire danger.

Reflections/Applications: I am not saying that synthetic materials should be condemned, only that greater care should be used with them. I feel that more precautions should be taken a th manufacturing stage.

#IS THERMOCHEMICAL SPLITTING OF CO_2 AND H_2O POSSIBLE IN PRASEODYMIUM COMPOUNDS? PHASE II

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The objective of this two year project is to substitute Praseodymium which has similar characteristics, for Cerium in a cycle that had been previously performed.

In the first phase I tried to perform the process which was hypothesized to work. However, the reactions did not occur because of unavailability of high temperature equipment. Continuing this year, for Phase II, I was able to first perform my process at the Oak Ridge National Laboratory in Oak Ridge, Tennessee. To test different variables and to improve the process "back home" I conducted experimentation in a laboratory at the University of Alabama in Birmingham.

Praseodymium reactions will produce the same quantity of $O_{2(g)}$ and $H_{2(g)}$ as the Cerium cycle. In addition, the project evaluates the effects of temperature on the production of fuel gases with the goal of determining the conditions under which the process is most efficient and economical. The products obtained were conclusively verified by x-ray diffractions and/or Raman Spectroscopy, thus confirming that the cycle worked as predicted.

I still plan to evaluate the applications of this process: (1) As a low cost energy source, (2) for use in space, or (3) any other use for which fuel cells are applicable today or could be substituted for tomorrow.

#Second Award - United States Air Force
Alternate Award - U.S. Department of Energy

TEXT BOOK ERROR

Peatross, Justin Bruce, Delta High School, Delta, Utah 84624;
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One of the standard procedures for the production of oxygen in the laboratory is the thermal decomposition of potassium chlorate with the presence of manganese dioxide, a catalyst. The traditional equation for this reaction, stated in chemistry text books, is $2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$. My experimenting has shown that for this reaction, not only is oxygen liberated, but also chlorine.

The amount of chlorine produced varies with the temperature at which the reaction takes place. At higher temperatures more chlorine is liberated from potassium chlorate and the reaction is much quicker than at lower temperatures.

Another parameter varying the production of chlorine is the ratio of potassium chlorate to manganese dioxide. As this ratio is varied the amount of chlorine produced is varied in an unusual manner. With small quantities of catalyst little chlorine is produced and the reaction takes place slowly. As more manganese dioxide is added to potassium chlorate chlorine production increases as does the speed of the reaction. This increase continues until the ratio reaches about two (2) parts $KClO_3$ to one (1) part MnO_2 by mass. Increasing the amount of manganese dioxide past this ratio causes a decrease in the production of chlorine and a decrease in the rate in which the reaction occurs.

I experimented with other catalysts than manganese dioxide. Those were iron oxide and powdered glass. I compared their trends with those of manganese dioxide.

THE ABSORPTION OF ULTRAVIOLET LIGHT BY SUNSCREENS

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Erythema (sunburn) is a direct result of over-exposure to radiation in the ultraviolet range of the electromagnetic spectrum. Sunscreens are effective because they absorb the UV radiation. The more radiation absorbed by the lotion, especially in the critical 2900 A to 3200 A range, the greater the protection to the user.

Seventy per-cent isopropyl alcohol was determined to be the most accurate and practical solvent for the sunscreens. It effectively dissolved the sunscreens and left an uncloudy solution which absorbed practically no UV radiation. The solutions were placed in a Spectronic 20 spectophotometer in glass tubes and tested from 335 nm to 420 nm.

Each solution, containing 0.02 grams of sunscreen, was tested for per cent-transparency in this range in increments of ten. In addition, one test was extended to demonstrate that sunscreens are basically transparent to visible light.

The results showed that different brands are most effective at different frequencies, but the effectiveness of all lotions generally improve as the frequency approaches the crucial 290 nm. range. The 0-15 rating for the sunscreens is accurate within a given brand for the purpose of determining the different levels of protection. However, these ratings do not compare strengths effectively across brands. In other words, a "15" of one brand does not compare equally to a "15" of another brand.

#AN INTERACTIVE PROGRAM FOR THE INTERPRETATION OF PATTERSON FUNCTIONS AND ITS USES

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The objective of this project was to design and create a FORTRAN program to serve as an interactive Patterson interpreter, aiding the crystallographer in solving heavy-atom molecular structures. By employing the Patterson function to X-ray diffraction data, it is possible to calculate Patterson peaks, maxima corresponding to vectors between atoms or pairs of atoms in a structure. PATTI (PATTerson Interpreter) has been written to interactively manipulate the Patterson vectors and thus solve molecular structures from the Patterson peaks. While most of the functions carried out by PATTI are trivial in nature, the program provides a convenient mechanism for keeping track of the various vectors and trial positions. PATTI allows the user to generate trial coordinates using combinations of the Harker lines and planes and to examine these trial positions for other interactions. Subroutines are available which allow the addition or subtraction of suspected interatomic vectors from trial positions already determined. Thus, the positions of the heavy atoms may be determined. The program, written in standard FORTRAN, was implemented on a CDC CYBER172 computer operating with the KRONOS operating system at Indiana University.

To date, PATTI has been used to solve many heavy atom structures. In only one case was the program unsuccessful, due primarily to noncrystallographic symmetry in the unit cell. As has been proved by these many trials, PATTI is a successful and useful Patterson interpreter.

#Honorable Mention - American Chemical Society

#APPLICATION OF SOLITON PATHS IN CYCLIC CONJUGATED CONFIGURATIONS TO A MOLECULAR COMPUTER

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As time goes on, the size of electronic devices is decreasing. At the present rate, one can predict that future computer switches will be reduced to the molecular level by the turn of the century. A recent theory, the soliton theory, suggests that molecules can communicate information by means of a soliton wave. Administration of these waves by electromagnetic energy is believed to cause bond rearrangement in moieties of polyacetylene. Two models of soliton propagation are simulated on a digital computer, to investigate soliton paths, to predict the cyclic configurations, and to evaluate polyacetylene as a molecular operator. The first model generates all the possible configurations obtainable from a given array of soliton wave entrances, while the second model determines all the possible existing arrays of wave entrances needed to execute given bond changes. With the data obtained from several case studies, a molecular operator is proposed. In conjunction, a formula is developed minimizing the number of carbons needed to support a stable, non-resonant ring structure constituting an operator. Data indicates that bond arrangements of certain configurations undergo geometric rotation when transited by one or more solitons.

#Fourth Award - General Motors ISEF
Honorable Mention - United States Air Force

#A STUDY OF CHEMICAL KINETICS IN ANAEROBIC MUDS

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This investigation was designed to test six factors and their effect on the rate of sulfate reduction in the interstitial pore water of marine estuaries. These factors include the following: salinity, initial temperature, excess sulfate concentration, excess iron concentration, and initial acid conditions. A study of pH changes during the reaction was made. Sulfate concentration was determined gravimetrically. A total of 122 samples was run, with control samples for comparisons.

Calculations using results of this investigation showed a close agreement with the first order rate of reaction reported by Kinard and others (JChemEd 56). It was concluded that the addition of excess iron II or sulfate ion depressed the rate of reaction, with iron II having the greater effect. A new finding not reported by others was the existence of cycles in the reduction reaction. Periods with a high rate of reduction followed periods with a depressed rate. These cycles were affected by changes in the initial concentration of sulfate, iron II, and hydrogen ion. An original equation was developed which correlates pH measurements and the calculated E_h (potential) of the system with the amount of sulfate reduced. The equation was found to be valid within a range of 10%.

The effects of "acid rain" conditions on the anaerobic mud was studied. It was concluded that acid rain has a detrimental effect on this ecosystem because of the excess sulfate it imposes on the environment, not the excess acidity. Three results of this project support this conclusion: (1) Samples initially adjusted to pH 4.0 rebounded to pH 6.4 within 24 hours; (2) Addition of excess sulfate ion decreased the rate of sulfate reduction; (3) Addition of acid, without increasing the initial sulfate concentration, did not reduce the rate of reduction.

#Fourth Award - General Motors ISEF

A Comparative Study of Pain Relievers: Elevation of Acidity in Gastric Solutions

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The purpose of my experiment was to study the different effects of pain relievers on gastric solutions.

My procedure was to crush five pain reliever tablets, weigh them, dissolve in hot alcohol, filter them, and let the solutions evaporate. The pain relievers were both aspirin and non-aspirin types. After evaporation, the salicylic acid crystals were weighed and observed. A percent of salicylic acid was calculated. Next I dissolved one pain reliever tablet in 250 ml. of water to titrate against a .1 N NaOH solution. I also titrated the gastric solutions obtained from a hospital laboratory against .1 N NaOH. One pain reliever was added to 250 ml. of gastric solution and titrated with .1 N NaOH again. The pH of the gastric juice was observed before and after the pain reliever was added.

The conclusions I came up with were the following: the stomach acid needed 1.5 ml. of .1 N NaOH to neutralize it without the pain reliever added and had a pH of 6. The stomach acid with pain reliever needed 2 ml. of .1 N NaOH to neutralize it and had a pH of 5. Supac was the most acidic pain reliever and had the most salicylic acid crystals. The non-aspirin Tylenol was the least acidic pain reliever and showed no salicylic crystals.

I conclude that the more salicylic acid an aspirin has the more acidic it makes your stomach.

EARTH AND SPACE SCIENCES

#FABRICATION OF A 73.8 MHz INTERFEROMETER SYSTEM AND THE DETERMINATION OF PARAMETERS THROUGH OBSERVATION

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Using the information available about previously constructed interferometer systems, a 73.8 MHz radio telescope was designed and constructed. During the observation period, a series of traces was made from thirteen distinct sources of cosmic radiation, the weakest having a flux density of 198 F.U.

By identifying the objects recorded and using their times and locations, parameters for the system were calculated. These values indicate the relative accuracy of the system and the success of the design.

#First Award - National Aeronautics and Space Administration
Second Award - United States Army

A COMPARATIVE GEOCHEMICAL AND ZONATION STUDY OF IRON MINERAL LIMONITE (FeO (OH).n H_2O) IN THE OLD MAIN BASE MMGA (MAYAGUEZ MISSILE GUIDANCE ANNEX) LOCATED IN CERRO LAS MESAS

Soto, Heriberto, CROEM High School, Mayaguez, P. R. 00708;
Urb. Quintas de Guásimas #C-15, Arroyo, P. R. 00615.

The main purpose of this study is to make a geochemical and zonation study of limonite at the old main base MMGA (Mayaguez Missile Guidance Annex) located in Cerro Las Mesas. A specific zone was selected which was characterized by a dark reddish-brown appearance and by the presence of iron particles in its grains. The study consists of two phases. The first one consists of the zonification of the area and the selection of 52 stations to choose limonite samples from each one. The second one consists of the use of a geochemical process called flotation (this process is used to separate the mineral that has a rock from the gangue). The soil pH conditions were determined for the 52 stations to find a relation between the percent of iron found in each station and their agricultural production. The results of these studies reveal that at a lesser pH the bigger the percentage of iron present in the soil. As the percent of iron in the soil increases it becomes more difficult for plant growth and reproduction because of the greater acidity of the soil.

#SALINITY EFFECTS AND SOLUTIONS TO CONTROLLING BACTERIOLOGICAL ACTIVITY IN FARMINGTON BAY

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The Farmington Bay area, the southeast arm of the Great Salt Lake, has been the receptent of sewage effluent for over 100 years. The building of the north and south causeways to Antelope Island has reduced the Bay's salinity. The causeways have isolated Farmington Bay from the majority of the heavy saline water, thus creating water quality problems associated with an increase in bacteriological activity.

Procedure A: Samples from Farmington Bay (F.B.) and the Great Salt Lake (G.S.L.) were diluted in eight two liter aspirator bottles. Controls: water temperature: 23.5°C, photoperiodism: 8:00am to 5:00pm, and agitation: 5 minutes daily. Day 1: F.B. and G.S.L. water samples tested for gram negative count, chloride, dissolved oxygen, nitrate, nitrite, and phosphorous content. Tested samples on nutrient agar and 10% NaCl nutrient agar. Theortical concentrations were calculated for all test on sampes 2-7. Day 10: Repeated all tests on every bottle (1-8). B: Three filtering systems were tested to determine relative effectiveness, on the Jordan river water (J.R.), the best leachate was then dripped through a simlulated duck marsh. Leachates were filtered through a membrane filter and tested for bacterial content.

Conclusion A: Bacteriological activity in F.B. drops at 8.6% NaCl. B: Best filtering system was a horizontal gravel, sand filter (A) drained into F.B. bird refuge.

The solution and resulting benefits: 1) More openings from F.B. to the bay through Procedure B, would improve light penetration and increase marsh plant growth, thus resulting in better feeding and nesting areas for waterfowl.

#First Award - Navy Ocean Research and Development Activity Award
First Award - United States Army
Second Award - General Motors ISEF

#VERTEBRATE PALEONTOLOGICAL WORK I HAVE DONE AND RESEARCHED

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My Science Project deals with the Vertebrate Paleontological work I have done and researched. One of the things I have done is, I have interpreted a Pleistocene Vertebrate fossil site located in Berwick, La. In order to interprete this fossil site, I had to do things such as, collect the fossils from the fossil site, determine their age, identify them, form an Environmental Interpretation, and so on. As a result of my interpretation of the site, we now have much previously unknown information about Berwick, La. during the Pleistocene Epoch.

Another thing I have done is, I have made a scientific discovery that might be useful in determining how old a Bison was when it died.

Some of the Vertebrate Paleontological work I have researched is, how to classify a previously unknown prehistoric animal, how to determine the external appearance of a prehistoric animal, how to determine the size of a prehistoric animal's muscles, etc.

#Fourth Award - General Motors ISEF

#Cyamopsis Tetragonoloba Release of crude droplets from heat treated oil shale and tar sands from selected sites in Utah.

Shanna Stitt, WEBER HIGH SCHOOL
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Oil reserves presently trapped in tar sands and oil shales are essential to the development of future energy supplies for our country. Present attempts to recover oil from these petroleum laden stratas has proven costly and inefficient. I have attempted to investigate an alternative means of recovery. Specifically I investigated the problem: Does guar bean slurry release microscopic crude oil droplets found in heat treated oil shale and tar sands? The economics of oil recovery could possibly be enhanced by using guar bean slurry in the extraction process.

Hypothesis:

If it is possible to recover crude from oil shale and tar sands by heat and guar bean treatment, then it is economically feasible.

From the photographic evidence which I have obtained, guar influences the release of oil droplets from oil barren sands and shales.

#First Award - Gulf Oil Corporation
Alternate Award - U.S. Department of Energy

#INTERPRETATION OF FIVE ANOMALOUS X-RAY SOURCES
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In 1979 the Einstein HEAO-II satelite was launched to observe the radio emissions of astrophysical phenomena, among them quasars. In the course of its observations it detected many previously undetected x-ray sources. It was hypothesized that some of these objects could be quasars. Due to the relatively low resolution of the telescope, though, the objects could not be pinpointed. I ooserved photographic plates and other records of stellar objects close to five x-ray sources near quasar 0735+17. First differences between blue and visible light emissions of the objects were observed on a blink microscope. Then, using a random photographic plate sequence covering approximately seven years, magnitudes of the objects were estimated against a comparison sequence of background stars. Analysis of these data provided ten promising candidates. The magnitudes of these objects were then measured on a Cuffey Iris Astrophotometer. A PET microcomputer was used to interpret raw data. Seven objects were found to exhibit at least marginal blue excess and pronounced variability. These objects were recommended to the University of Florida for spectrographic examination. Should sufficient red shift be evidenced, the object shall be designated a quasar and begin undergoing routine examination.

#First Award - National Aeronautics and Space Administration
Second Award - General Motors ISEF

#IS THERE A FEASIBLE LINK BETWEEN FUSION REACTORS AND THE BIRTH PROCESS OF A PROTOSTAR?

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The researcher probed into the aspects of using the process of which a protostar is formed and making it feasible in the process of fusion reactors.

The researcher predicts that from a five year investigation of the elemental and structural composition of a protostar, in a recreation of a protostar in its premordial stage one can recreate a successful fusion reactor. By recreating the deuterium-tritium reaction, the protostar reaction would create this process, but in a slightly different way than just taking sea water and filtering it through. By taking the hydrogen and oxygen and creating deuterium, the lithium to produce tritium would already be present, so the need for the lithium to produce tritium would not be necessary. The carbon produced would act as a natural insulator to keep the outer process from a melt-down of any type.

The process was by spectroscopic analysis of M20 and M42 with the particular elements involved with nuclear fusion.

In conclusion, the fusion reactors, that are in the experimental stage, at Princeton and UCLA have concluded to this deuterium-tritium combination. This process proves to be economically feasible for fusion reactors.

#Second Award - United States Air Force

#STELLAR LIGHT CURVES

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The purpose of my project was to determine the light curve of an eclipsing binary star system through the use of photography and computer technology. In such a star system, variations in magnitude are caused by the periodic eclipsing of one star by another component. If all the details of the variation of the light are measured and plotted against time, the light curve of the binary will be obtained. I took time-lapsed exposures with a 35mm camera and Tri-X film of well known eclipsing binary stars within the period of one of their orbits. The density of the star on the negative is inversely related to the star's magnitude. In this relationship, the lower the magnitude, the higher the density. I measured densities of reference stars on my negatives using a densitometer and obtained the magnitudes of the stars from the "Catalogue of Bright Stars". To determine a relation between the densities and magnitudes of my reference stars, I wrote a computer program based on linear regression that will use any ordered pairs and find an equation of the line that best satisfies the points. I entered my data into this program, obtained an equation, substituted the density of the variable, and found the magnitude of the variable for that specific negative. Using these exposures, I was able to determine variations in magnitude and therefore the star's orbital position with respect to the light curve.

#Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

#Laura Trauth
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A CONTINUING ANALYSIS OF ALLIGATOR & CROCODILE TOOTH MICROSTRUCTURES & THEIR POTENTIAL FOR EVALUATING HIGHER SYSTEMATICS

Although naturally shed alligator and crocodile teeth are some of the most commonly found Cretaceous fossils of North America, they have little taxonomic importance unless they are still lodged within a much rarer fossil skull and identified through skull fenestration. Results of a previous phase of this project suggested that internal ring structures of such teeth might be genetic invariants and, thus, have taxonomic value.

This phase of the project devises a means by which individual teeth may be quantitatively identified through their dentine ring systems; making the presence of a skull unnecessary. The teeth used in this study were known modern teeth from two families of crocodilians and unidentified fossil teeth. The teeth were evaluated mathematically, with the equations describing the curves of the dentine rings as the discriminating factors. The equations were found to differ at the species level for modern teeth. The fossil teeth were less easily classified because of their unknown character and interfering subring structures.

These structures were found to have probable counterparts in modern teeth soaked in a protease solution. The fossil teeth and the protease-treated modern teeth were less fracture resistant than non-treated modern teeth--suggesting that protein is a strength factor. This hypothesis requres further research.

Thus, as well as providing a model for identification of individual crocodilian teeth, this study suggests that some fundamental aspects of tooth structure may be better understood through study of tooth proteins.

#Glenn T. Seaborg Nobel Prize Visit Award
First Award - American Association of Petroleum Geologists
First Award - Eastman Kodak Company
First Award - General Motors ISEF
Second Award - United States Navy

SIZE VARIATIONS IN THE FOSSIL MARINE DIATOM *ACTINOPTYCHUS HELIOPELTA*

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Actinoptychus heliopelta is a fossil marine diatom species which has been dated Miocene by the U.S. Geological Survey and determined to be of the Calvert formation. This species has only been located at a few sites in the world. The purpose of this research was to determine the size variations among specimens of *A. heliopelta*.

Diameter of the valves from two sample sites were measured using an eyepiece micrometer and difference in morphology (number of sectors) was noted. Sizes were determined, categorized and recorded according to number of sectors in each specimen. Mean diameters were determined and the results are as follows: 6 sectored - 87 µm, 8 sectored-129 µm, 10 sectored - 183 µm, 12 sectored - 233 µm.

From this research the following conclusions were made: no significant size differences were found for species from the two sample sites. The diameters of *A. heliopelta* were increasingly larger as the number of sectors increased. Statistical analyses were made in order to predict valve sizes for any group of specimens of *A. heliopelta*. Further studies are planned using samples taken from various levels throughout the entire Calvert formation sedimentation layer.

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THERMAL EFFECTS OF CARBON DIOXIDE ON ICE NUCLEI FORMATION

This project deals with the CO_2 greenhouse effect on the formation of ice nuclei in the atmostphere. Ice Nuclei are small airborne particles that are responsible for the formation of atmospheric ice crystals. These crystals are in turn responsible for the existence of the cirrus cloud level. However, these ice nuclei must have temperatures of -10° to -12°C in order to transform into ice crystals. If the CO_2 level continues to rise, so will the atmospheric temperatures. The CO_2 level is linearly proportional to atmospheric temperature. The rise in temperature will deprive many areas in which ice nucleation takes place. This will result in an absence of the cirrus cloud level in many areas.

A portion of this experimentation includes a collection of atmospheric particulate matter and the effect of CO_2 on ice nuclei formation. In conclusion, this project shows that the CO_2 greenhouse effect is capable of preventing the formation of ice nuclei in the atmosphere.

#Honorable Mention - American Meteorological Association

#SOLID STATE NUCLEAR TRACK DETECTION OF SUBTERRESTRIAL FLOW OF RADON AS A PRECURSOR OF SEISMIC EVENTS

-A FOUR SITE ANALYSIS-

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Cellulose nitrate, Terradex detectors, and the AlphaNuclear alpha meter-400 were used in this research to determine radon concentration. The cellulose nitrate and the Terradex detectors were exposed for a seven day period each to radon emissions in the earth at a depth of one meter in Lauderdale by the Sea, Florida. The decay of radon (222Rn) produces a charged-alpha particle of 5.49 MEV. These energetic particles strike the detectors and produce a region of permanent castrophic atomic damage. The radiation damage tracks are then revealed by caustic etching.

The alpha meter-400 was placed in three regions of the State of Florida-North, South, and West. These sites are located at Ponte Vedra Beach, Lauderdale by the Sea, and Nocatee, Florida. A fourth location at Warner Robins, Georgia, monitors the central region of Georgia. The data from these sites were then studied and compared with the results of the cellulose nitrate and Terradex detectors.

Seismograms from this author's seismograph were an important part of this research. These earthquakes were compared with the solid state detectors data. The relationship between this data and recent earthquakes was analysed, and the possibility of the subterrestrial flow of radon as a precursor of seismic events was realized, even recording the tectonic eruption of ash and gas from the volcano El Chichonal in Mexico, which was preceded by a two month increase of radon emission.

#First Award - BDM Corporation
First Award - Society of Exploration Geophysicists
Third Award - General Motors ISEF
Honorable Mention - United States Air Force

#SOIL TEXTURE OF RIVERINE TERRACES

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The area south of the American River (near Sacramento, California) between the town of Folsom and Bradshaw Road has some unique geomorphic features. These features, riverine terraces, have developed over the past million years as the American River has gradually migrated northward. (Sunrise Blvd. crosses all 6 terraces between the Sunrise Bridge and Jackson Road.)

The soils on these terraces appeared somewhat different from each other, so I decided to compare the soil of each terrace with regard to its texture. I suspected that the older terraces with the older soils would have smaller sized particles than the younger soils near the river. I had read that weathering processes, with time, create smaller and smaller texture size.

In my study, I took five 350 g samples of each of the 6 terraces, dried them, and used a separator to sift them into 7 textures. Each texture was weighed, converted to a percentage, and compared. I found that the amount of the smallest textured particles (silt and clay) increased slightly from the first terrace (the one nearest the river) to the sixth terrace. The amount of silt and clay in the first terrace was 16% as opposed to 22.2% that was found in the sixth terrace. Since the age of the terraces increases as one moves from the river (10,000 to 1,000,000 years), the correlation between the increasing age and decreasing size of the particles is established.

#Third Award - Bureau of Reclamation/U.S. Department of the Interior

#STATISTICAL ANALYSIS OF LENGTH TO WIDTH RATIOS OF BRACHIOPODS

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1399 Vista Leaf Drive, Decatur, Georgia 30033

The objective of this study was to determine whether the ratio of length to width is a characteristic property of each species of brachiopod. Sample populations used in the study came from the Silurian Red Mountain Formation at the Ringgold Gap site in Catoosa County, Georgia, and from Devonian brachiopod collections at the Georgia State University Geology Department. Ten species were used, with sample sizes ranging from eleven to 135. Length and width measurements were made on each specimen, ratios of length to width calculated for each, and mean ratio, standard deviation, skewness, and kurtosis were calculated for each species sample. Frequency distribution histograms were plotted with a ratio interval of .03 and scattergrams were constructed with linear regression model and correlation coefficient for each species studied.

Results of the scattergram studies indicate that ratio does change over time with age in some species. The ratio appears to increase as specimens mature in some species, and decreases in others. This feature, caused by asymmetric growth, necessitates setting a standard population age distribution for any comparative studies. It was concluded that the ratio of length to width is a characteristic property of certain species of brachiopods when taken as a mean of sample populations with similar age distributions.

Future study in this field could involve determining the effect, if any, of geographical location or environmental conditions on statistical data. Compiled data on these ratios would be of great aid to the classification and study of brachiopods.

#Second Award - American Association of Petroleum Geologists

#PHOTOMETRIC OBSERVATION OF DIMMING PHENOMENON IN TOTAL LUNAR OCCULTATIONS

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The purpose of this project was to research a phenomenon found in total lunar occultations of stars known as dimming. When occultation occurs, the time the star takes to disappear or reappear should be virtually instantaneous. Instead, stars sometimes disappear or reappear over periods of time known as dimming. This presents a serious inconsistency with current theory regarding occultations.

To test the possible hypotheses, photoelectric photometry was employed to determine the time of event for several occultations and correlate the data to known information and variables. A system was employed to combine a photometer signal and a sound signal to produce a sound with an amplitude directly proportional to the photometer output level. This was recorded on tape. The tape was then played into either a trace-memory oscilloscope, or a video tape was made of the signal played into a regular oscilloscope. The impulse was reviewed until the event was located as a change in amplitude. The duration of the event in seconds was recorded, or if the event was instantaneous, that was recorded.

From the data collected so far, the theory that appeared to be most strongly supported was that stars do have a real image size sufficient to produce a recordable dimming phenomenon in some cases. This was based on observation of a number of occultations and deducing the most reasonable and consistent explanation based on the data correlated.

#First Award - National Space Club

#LIESEGANG RINGS: THEORY AND APPLICATION TO BANDED ROCK

Cruttenden, Lisa, Barry H.S., Barry, IL 62312
Frankden Orchard, Barry, IL 62312

The purpose of this research investigation is to find out how banded silicate rocks such as agate and malachite, form in nature. An investigation of literature regarding chemical geological proceeses and the formation of Liesegang rings in silica gel was conducted. A hypothesis was formed that banded silicate rocks, such as agate and malachite, were formed by leaching ions through a carbonated silicate system. Three methods of creating a carbonated silica gel were devised for testing. Once the gels were set, then metallic ions were placed upon the gels in test tubes, in hopes of precipitating and forming Liesegang rings. Each method used produced a suitable gel at some point during experimentation. All methods except the carbon dioxide method were found to form a couple bands of rings under specific conditions (ie. dependent on concentrations used, p^H of gels, temperature conditions, etc.) Many variables are involved in the formation of the Liesegang Rings. The conditions in nature are also many and varied. Further experimentation investigating the variables may help verify these conditions. Specific investigations include the use of a carbonic buffer, and the principle of the complex dilution method.

#Fourth Award - American Association of Petroleum Geologists

#DIFFERENTIATION OF JUPITER'S IO AND NON-IO RELATED RADIO EMISSIONS

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The Radiation Cone Theory states that cyclotron radiation from the planet Jupiter is emitted in two beacon like cones: one which moves as Io (Jupiter's closest Galilean satellite) orbits Jupiter, and a second whose movement is independent of Io's position. The Io-related cone is presumed to emit stronger radio waves than the Io-independent cone; therefore, the separation of data into strong and weak categories should have allowed separate analyses of the Io-related and the Io-independent sources.

Jovian radio emission data from 1973/74 to 1980/81 were separated into strong and weak categories and plotted by computer. The positions of peaks of activity were calculated using the ½ Power Point method of analysis. Peaks from the eight years of data were then examined to determine variations in location of radiation sources.

Data separated into strong (Io-related) and weak (Io-independent) categories exhibited Io influence throughout. Radiation source locations shifted over the eight-year period yet no definite cycle of movement was evident. However, consistency of plotted data confirmed the existence of the Io-related radiation cone.

Since data separated into strong and weak categories were inconclusive, different criteria must be established in order to distinguish Io-related emissions from Io-independent emissions. As for a cycle of shifts in radiation source location, at least four more years of data will have to be analyzed in order to establish its existence since Jupiter's revolutionary period is twelve years.

#First Award - United States Air Force
Fourth Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

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AZIMUTH AND ALTITUDE ANGLES: THEIR RELATIONSHIP TO A SOLAR COLLECTOR

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This project tests the energy absorbing capacity of fixed angle, stationary solar collectors against those that can vary the direction of their collection surface to adjust for the sun's seasonal and hourly positions in the sky (solar altitude, solar azimuth).

Ten simple solar collectors were made from thin, steel sheets, painted black and then exposed at differing tilt angles (0° to 90° to the southern sun. One additional collector was constructed so that its surface could be adjusted for both the altitude and azimuth. Another plate was set at a fixed 42° tilt angle but allowed to vary only its azimuth angle. Forty-two degrees was chosen because my research indicated that the most efficient, year round angle to tilt a stationary solar collector would be the location's latitude plus ten degrees. Marianna's latitude is 32° north; hence, $L + 10^\circ = 42^\circ$.

Temperature readings were recorded hourly on June 21, September 19, and December 21, 1982 or the first day of each season. March 21 (the first day of Spring) was not tested because these tests would yield the same results as the September test.

The collector that varied both solar angles consistently gave the best performance, followed closely by the collector whose azimuth alone could be varied. This is because the collectors that could be adjusted for the solar azimuth and altitude changes minimized the angle of incidence of the sun's rays on the collector surface. It should be noted, however, that while they both out performed the fixed angle, stationary collectors, the difference was marginal.

WEATHER FORECASTING

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The purpose of this project is to construct and maintain an accurate weather station in order to reach precise methods for determining forecasts. To do this I first constructed weather instruments and tested their accuracy. I then recorded data daily (which I have done for the last five years) to make weather patterns and climatic trends. I also conducted experiments to aid in the formation of forecasting methods. I preceded to test them and make forecasts. Finally, I tested the accuracy of my forecasts. Results show that my most accurate homemade instruments are as follows: air barometer, wet/dry bulb hygrometer, sling psychrometer, rain gauge, and breeze indicator. The most accurate methods are: clouds, chart use, and weather patterns/climatic trends. It also showed my forecasts to be 99% accurate. In conclusion, I found 1979 to have the most precipitation, 1980 to have broken the most temperature records, 1981 to be the driest, and 1982 to have been the coldest. My project displays my homemade weather instruments along with the charts I use and a weather file I have compiled from daily papers from the past six years. It also contains pictures I have taken of various types of clouds and pictures of my visits to the National Weather Service.

#RADIO MAPPING WITH THE "VSA"

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There are unlimited amounts of radio waves in the universe. It is the objective of this years project, after two previous years of work with radio telescopy, to seek out all possible sources at 162 MHz. All data was collected from a six antenna, Yagi-Uda array, radio antenna, which was constructed last year.

Data was compiled by three methods; first by direct reading (from the volt meter), second, a pen recorder and thirdly, through use of two different computers, interfaced with an analog to digital converter.

Data was taken from 60 degrees south of the Zenith to 20 degrees north of the Zenith.

In order to perform an observation, the antenna was aligned in the desired declination. Then, the natural rotation of the earth moved the antenna past the celestial sky.

According to the test data 43 sources were detected. Seven of these were detected more than once. Eleven of these were previously observed by other radio astronomers.

The "VSA" (Very Small Array) has demonstrated its ability to detect extra-solar radio emissions. The sensitivity of this radio telescope is much higher than expected. The reason for this is probably because of the addition of a different radio, which has a higher bandwidth, than the radio previously used.

The addition of a computer, with an analog to digital converter, has made data collection easier and more dependable.

The addition of another antenna and a new specialized receiver will be the objectives for the "VSA" in the future.

#First Award - National Aeronautics and Space Administration

Third Award - General Motors ISEF

VARIATION OF ACCELERATION OF GRAVITY VERSUS TIME

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This project attempts to find a variation in the acceleration of gravity due to the affect of the moon on the earth. This assumption is made due to the fact that the moon affects the tides. The first method used to find a variation in gravity was with a freely falling body. This method proved ineffective in that a 48 cm/sec^2 change in gravity in less than half an hour was observed. Gravity could not possibly change that much, so this method was abandoned in favor of another method. The most feasible method was the simple pendulum using the classical equation $T = 2 \quad l/g$. To measure the time period of the pendulum a high speed timer using a 4 MHz quartz crystal oscillator was constructed. This signal was divided by 16 in a prescaler and the resulting 250 KHz signal was applied to a 24 stage binary counter. With the use of a phototransistor to start and stop the timer, measurement of the time period with a resolution of 4 microseconds could be made. The first test used a monofilament fishing line and a small plumb bob. After several weeks of recording data it was discovered that the plastic monofilament fishing line was absorbing moisture and was changing length with a change in humidity. Three additional pendulum designs were used with the present design giving readings with a repeatability of .01 cm/sec^2. (.01 cm/sec^2 980 cm/sec^2 = .001%) This kind of repeatability is sufficient to measure the variation of gravity as a function of latitude but a resolution of .001 cm/sec^2 is needed to measure the moon affect. Pendulum design is continuing.

ANALYSIS OF WEATHER PATTERNS AFFECTING NORTH-CENTRAL TEXAS

North-Central Texas

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This project involves weather analysis research in three areas: (1) collection and analysis of local weather data; (2) collection of weather records from selected cities across the United States; and (3) programming and analyzing data by computer.

Local weather data collection began January 1, 1982, and continues to present. Analysis was based on one year, ending December 21, 1982. Basic weather data; temperature, humidity, barometric pressure, precipitation, wind velocity and direction, and cloud cover, was accumulated on a daily basis.

National weather data was collected by library research and from U.S. Weather Bureau records. This data was analized to detect basic weather patterns.

Methods were initiated for utilizing the computer to organize and interpret the data.

Studies of U.S. Weather Service records covering a 36 year period revealed two geographical weather patterns for the local area. One pattern was a dry line which formed when two low pressure areas were positioned in such a way that compression of the intermediate air mass occurred. Another pattern resulted when the friction from a frontal boundary caused a type of secondary front or trough or low pressure to produce severe thunderstorms in the spring and produce snow during winter.

GEOTHERMAL ENERGY: THE HOT WATER SYSTEM

Lam Huu Do, Northeast H.S. OKC., OK. 73111
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Geothermal energy is defined as the using of the earth's heat to produce electricity. Geothermal systems are basically divided into three classes: dry steam, wet steam, and hot water systems. The dry steam and wet steam systems exist mostly along fault lines (they are very rare). These two geothermal systems are the most productive in producing electricity.

The hot water geothermal system is the most abundant in the world because it exists in almost any area. These systems contain water that have temperatures below 100°C. To utilize these systems, special power plants must be developed. These power plants must contain heat exchange systems that are capable of absorbing the heat from the "natural hot water". These heat exchange systems use low boiling point liquids such as freon, ammonia, and isobutane to absorb the heat and drive the turbine.

The heat flow that is found in many areas around the world is very high. Unfortunately, these areas usually do not contain "natural geothermal reservoirs". There is a way in which we can extract this energy. Two geothermal wells are drilled. The "hot rocks" are then fractured by using explosives or hydraulics. Water can then be pumped directly into one well and out the other. These hot waters can the be used to generate electricity in a power plant containing a heat exchange system. The hot water system can be used at almost any location around the world. It is a "universal system".

ENGINEERING

ASSESSMENT OF SUN TRACKING VS. STATIONARY SOLAR COLLECTOR SYSTEMS PERFORMANCE COMPARISON

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An experimental program to assess the capabilities of a solar tracker and a stationary solar collection system was conducted. The components were individually evaluated over a range of variables and parameters; the data was curve fitted utilizing the least squares approximation and the design trends were determined. An analysis was then employed to conduct sensitivity and trade-off studies to yield the optimum system design.

The performance of the sun-tracker system, which utilizes a parabolic reflector was determined under various off-optimum conditions to determine its tolerance to changes in major parameters.

The results indicate that this system performs acceptably well up to approximately 2° misalignment. The stationary configuration design simulates a compound parabolic reflector system, and the operation of this system over the entire range of performance was determined.

#THE CONSTRUCTION OF A PARABOT FOR THE BASIC MANIPULATION OF OBJECTS

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A parabot, a machine designed to perform specific functions and operated by a human or prescribed program, was constructed of readily available materials and salvaged parts. The parabot was designed to manipulate and retrieve objects from a remote location through a control console and a closed circuit television system. The project involved the designing and testing of mechanical and electrical systems to provide an integrated approach to mobility, manipulation, feed-back, and monitoring.

The parabot was driven by two high-torque, electric motors (15 inch-pounds) which resulted in speeds ranging from 1.2 to 4.8 km-hr^{-1}. The drive system was controlled by a microswitch assembly through radio-controlled, servo motors. The independently driven wheels coupled with a swivel-wheel assembly resulted in a turning radius of 68 cm. The design also included considerations of vehicle stability and clearance, accomplished through a compromise of overall weight distribution and wheel axle placement.

Mechanical "arms" incorporated the use of hydraulic cylinders for strength. Acme-type thread assemblies were employed to open and close a "claw" mechanism. The "arm" also used an acme-type thread assembly to extend or retract it to its full length. The second arm incorporated a "wrist" assembly with a manually-operated "claw", and moon-shaped gear to provide right/left movements. The closed circuit television system along with microswitch assemblies serves as the feed-back system.

#Fourth Award - General Motors ISEF
Meritorius Award - United States Army

MANTIS I: AN ARTICULATED SERVO-MECHANISM CONTROLLED BY COMPUTER

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Robots are swiftly filling many gaps in our everyday lives. American industry is incorporating robotic applications more and more everyday.

Mantis I, a robotic manipulator, is built very much like his industrial brothers. Most design concepts are the same, with size and power being the major differences. Five axis of movement provide freedom of movement in the immediate area that Mantis I commands. D.C. motors coupled to gear reduction units provide power through a chain drive. A closed-loop system of voltage dividers (using potentiometers) provide sensing of all axis movement. The feedback system is being monitored by an eight channel analog to digital circuit contained on the main computer board. The computer is a Z-80A system clocked at approximately 4 MHz. It has 32 bi-directional ports for control, A-D convertor, 4K byte program memory-monitor, 4K bytes of random access memory, and an alpha-numeric display. Mantis I is able to learn under direct control of the keyboard and then step through the program without further help. Immediate plans call for monocular vision with a ranging system for sensing and acting on objects within its workspace.

The entire body and arms are made from two aluminum stop signs and drive components salvaged from defunct photo-copiers. Drive motors are made from portable screwdrivers.

#DEVELOPING AND ANALYZING A HOME COMPUTER MONITORING AND CONTROL SYSTEM

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DEVELOPING AND ANALYZING A HOME COMPUTER MONITORING AND CONTROL SYSTEM

This research project involves computer monitoring of appliance operation and temperature in the home, analyzing the collected data, and utilizing the computer as a control system. The project was conducted in four phases. The first one consisted of designing and constructing the following:

1. An interface to input and output data.
2. Appliance monitoring equipment.
3. An analog to digital converter to monitor temperature.

Part of this phase was writing software to develop a computer monitoring system. In the second phase the data was analyzed to find possible appliances that could be made more efficient through the use of computer control. Other possible control applications were also considered. The next phase of the project consisted of designing and constructing these electronic control devices as well as writing software to integrate the monitoring and control devices into a system. In the last phase the appliances were remonitored and the data analyzed to determine the effectiveness of the control equipment.

In conclusion it was found that the computer can save energy and perform many useful functions around the home.

#First Award - Institute of Electrical and Electronics Engineers, Inc.
First Award - United States Army
Second Award - General Motors ISEF
Second Award - United States Navy

MATERIALS ECONOMICS AND TESTING

Susan Perrigo
Robert Service High School
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My scientific endeavor this year is a continuation of my atmospheric corrosion studies, now in three different locations. Testing racks are positioned in Richland, Washington, Cedarhome, Washington, and Anchorage, Alaska. The corrosion rate results collected at these sites are sent to the American Society of Testing and Materials and Reynolds Metals Company, located in Richmond, Virginia, to be added to their internationally collected data. Corrosion rate data gives a basis for coatings or other types of protection necessary to maintain the lifespan of metal structures.

Up until this point there has been no atmospheric corrosion data collected from any of my testing locations. In fact, in the entire state of Alaska no such tests have been previously undertaken. In order to calculate lifetimes of metals and annualized cost data, such data is necessary. My study and results will benefit both designers and engineers by giving them a basis for economic calculations.

My project entails quantitative analysis, by calculating the penetration in mils per year of different metals in different locations, qualitative analysis, by observing the adherance of different coatings and economic analyses to prove that corrosion data is necessary.

QUANTITATIVE STRUCTURAL SECTION STRENGTH ANALYSIS

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The strength of a structural section depends largely on its moments of inertia. These moments are determined about the section's two mutually perpendicular axes of symmetry in a standard strength analysis.

The purpose of my project was to develop a more extensive analysis of the moments of inertia of structural sections.

To achieve this purpose, I derived general formulas for determining the moments of inertia of structural sections about any axis, rather than about the standard two axes. The location of the axis is given by an angle of rotation, measured counter-clockwise from vertical to the axis. In practice, I applied the rotation formulas to the points and lines that represent the structural section in order to rotate them clockwise (rotating the section clockwise is the same as rotating the axis counter-clockwise). Then I applied integral calculus to these new, rotated functions of lines and points in order to determine the moment of inertia about the axis. One difficulty is that the function definitions in the integrations change at times as the angle of rotation changes.

I found computer analysis and interpretation necessary due to the complexity of my derived formulas. I programmed a computer to calculate the moments of a pre-defined section as the axis was rotated from 0 to 360 degrees, and to plot this information in polar coordinates. The result was a complete map of the moments of inertia of the section.

I found that my analysis (especially the inertia map) provides vitally useful information. The map clearly shows the minimum and maximum strength areas of the section. The map therefore identifies where a column with a particular cross-section should be braced to provide maximum strength. From the map, the moments of inertia of a section in various directions can also be compared to determine the section's relative efficiency. This information would be very helpful in designing new sections.

#IMPROVING SOLAR CELL EFFICIENCY WITH COMPUTER CONTROL

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One of the major problems with solar energy is the cost versus efficiency factor. Solar cells are both very expensive and very inefficient. The main goal of the research was to discover how much a solar cell's efficiency could be improved, over an entire day, if a energy seeking system was used. This system would allow the cell to search for the highest energy available in the sky. The system was computer controlled and constantly monitored the output of two similar solar cells, taking readings and storing them for analysis every 45 seconds. The system continually attempted to seek for the highest available energy with one of the cells. After taking weeks of data it was found that the efficiency improvement was greatest on sunny days and on partly cloudy days (days with a changing cloud cover or moving clouds). The improvement was minimal on overcast days. On overcast days the seeking system did little other than point directly upwards.

This indicated that a seeking system might be a worth while investment in a climate where it was mostly sunny or partly cloudy. However, a seeking system would not be worth the investment in a generally overcast area.

#Third Award - General Motors ISEF

Alternate Award - U.S. Department of Energy

#DEVELOPING A HOVERCRAFT (FULL SCALE)

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This project is about designing and building hovercraft to try to find the best design. The beginnings of this project go back to 1979. It was started as a model made of paper and balsa wood powered by a toy electric motor and progressed step by step. Each model taught me something about hovercraft designs. After numerous models, some of which were gasoline powered and radio controlled, I determined that I knew enough about hovercraft to build a full scale craft. I knew that it would take a considerable amount of funds to build such a craft, so I decided to rebuild one with my designs. I located a hovercraft that was no longer functional. In addition to not being functional it was originally designed for water use only. I made the craft functional and operable on land as well. The main point of interest in my designs is the skirt design. The current skirt design is the best skirt design I have come up with so far. I named the skirt design "The Lajvardi Skirt Assembly" (L.S.A.). The craft works and handles well. The base of the craft has approximately a six inch ground clearance. The craft has about eight hours of flight time, and there is no skirt damage at all.

#Honorable Mention - Eastman Kodak Company

*ELECTRICITY FROM THE MOTION OF WAVES

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The purpose of this project was to design, engineer, and construct operational small scale electric generating models of possible future power plants. These plants would operate utilizing the cyclic up and down motion of ocean waves.

The up and down motion of ocean waves has great potential as an electric generating mechanical force. The world's oceans and lakes possess a vast amount of energy and these power plants have great possibility in harnessing some of that vast source.

After constructing the four models, I put them in operation in the Gulf of Mexico. On ten various days of sufficient wave action I measured and recorded the actual voltage output for each model. I also measured and recorded wave amplitude and frequency to show their combined effect on the output of each model. To apply this voltage to electrical use I ran the voltage through a voltage regulator into an automobile battery in order to charge it.

Out of the four models I tested, the ratchet driven model, which operates with an action similar to that of a piston, operated best. I generated the most voltage, a maximum of seventy six volts, with this model. This model also proved to be the best in my experiments as it requires no focusing on the waves and it can easily be engineered to meet the maximum variation in wave conditions.

#First Award - General Motors Corporation
First Award - U.S. Department of Energy
Honorable Mention - Gulf Oil Corporation

# A STUDY ON A NOVEL ELECTRONIC MUSIC SYNTHESIZER

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The purpose of this study is to design a novel electronic music synthesizer which has improved characteristics over some existing IC synthesizers.This study has gone through a series of procedures including information collection and analysis, some studies of related fields,(i.e. acoustics, electronic circuits and computer programming) the system design, the circuit layout and testing, and finally, the system testing and evaluation/discussion.

The major contribution of our study is the demonstration of the feasibility of improving the performance and characteristics over the existing IC music synthesizers.
Some major points are:

1. A programmable and flexible wave-form processor.
2. Increase the number of synthesized music channels (or emulated instruments) to 15.
3. Separate wave form, wave envelop, hamonics and timing control of each music channel.
4. Easy operation.

The proposed structure can be implemented by integrated circuits and hence this study provide valuable information for manufacture's considerations.

#Second Award - Institute of Electrical and Electronics Engineers, Inc.

#A COMPUTER NETWORKING SYSTEM USING PULSE WIDTH MODULATION

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Networking allows the best of the single user microcomputer and the multi-user minicomputer. By connecting many single computers together and allowing them to share their resources, a complex system can be put together at a minimum of cost. Connecting the computers together is physically easy, but making them communicate in a quick orderly manner is a challenging task.

With this in mind I have investigated some different methods of speeding up the communication between two or more computers. After investigation of many other methods of modulation, converting computer data into a form that maybe sent over the telephone. I settled on studying Pulse Width Modulation (PWM). This method has the distinct advantage over all other methods of modulation in that it can encode data into one signal change instead of the eighr or more needed in other modulation methods. Because it only uses on signal change, data can be sent at a rate closer to the Shannon Limit. The Shannon Limit predicts the maximum transmission rate based on the amount of noise present on the transmission line.

Pulse Width Modulation is accomplidhed by turning a singnal "on" for a time period proportional to the data value, i.e. if a value of 20 was to be sent the signal would be on for 20 ms. Using this method of modulation as a base I have been developing a computer network system that should be able to transmit data between its individual elements, across telephone lines eight times faster than is currently being used.

#Fourth Award - General Motors ISEF

#IMPACT PROPERTIES OF SHEET MOLDING COMPOUND R-50

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Sheet Molding Compound (SMC) R-50, a glass-fiber reinforced plastic, is one of the new materials developed to aid the auto industry in meeting federally mandated fuel economy standards by the use of lightweight materials to replace heavier ones like steel. The ability of this material to withstand impact is of considerable importance and can be affected by the working environment of the car (temperature, chemicals, humidity).

The purpose of the research was to determine the impact properties of SMC R-50 under high rate and low rate deformation as a function of temperature and sample orientation (front vs. back).

At each of seven temperatures from -196°C to 100°C, twenty samples were high rate impacted (10:front/10:back), 140 samples total. At each of three temperatures from -71°C to 75°C, four samples were slowly deformed (2:front/2:back), 12 samples total. Energy or force required to fail the sample and failure angle were recorded.

Both impact energy and failure angle decreased as sample temperature increased. These values varied with the orientation of the material's surface to the impact force, and delamination occured at low temperature testing.

These tests will help to determine if, how, and where this material is used in automobiles, and what special design considerations will be needed.

#First Award - General Motors Corporation
Third Award - General Motors ISEF

#MONOCULAR DEPTH PERCEPTION DRIVING AID

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PROBLEM: There are 3,850,000 rear end collisions each year as a result of drivers not being able to determine safe distances.

Three percent of our population suffer from "lazy eye" (Ambolipia Exophoria). Nine percent of our population suffer from stereoptic vision. These 12,600,000 people with depth perception difficulties have greater problems with distance judgement than those with normal vision.

Drivers with permanent and temporary monocular vision have a total loss of depth perception and have to guess at road distances by object comparision. This is very difficult and dangerous.

OBJECT: 1) Develop an inexpensive device which can be added to the windshield of vehicles to give direct readings of road distances.
2) Derive a formula so the device can be used on all makes of vehicles.
3) Have device tested by drivers with normal vision, permanent monocular vision, temporary monocular vision, lazy eye, and stereoptic vision.
4) Develop a computer program which can be used by automotive manufacturers so they can produce this device for all vehicle designs.

RESULTS: Four variations of a Monocular Depth Perception Driving Aid were developed and tested 1) white tape indicator, 2) black tape indicator, 3) prismatic indicators and 4) fiberoptics. These devices were tested on the windsheild of a vehicle for 3600 miles. Test drivers ranged from normal binocular vision to permanent monocular vision. Test results proved the device to be useful and practical. For an additional cost of seven certs per vehicle this device can prevent 3,850,000 accidents per year, provide depth perception for 12,600,000 sufferers of "lazy eye", stereoptic vision, permanent and temporary monocular vision, and give all drivers a means of determining safe distances.

#First Award - General Motors Corporation
Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Third Award - Auxiliary to the American Optometric Association
Fourth Award - General Motors ISEF
Honorable Mention - American Medical Association

ENGINEERING BICYCLES FOR EFFICIENCY

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The bicycle is the most energy efficient machine known to man and in the past few years has been gaining popularity as a means of transportation. The conventional bicycle has many disadvantages: it has the rider placed in a head first position, its wind resistance is high because of a large frontal area, and its method of obtaining power from the legs lies in the weight of the individual and the strength of his arms. I designed each bike in order to achieve a safe and aerodynamically sound bike. My recumbent bicycle utilizes the need for a more aerodynamic shape by placing the rider in a position with the least frontal area. This produces a faster and more energy efficient human powered machine. The reclining recombinant bike utilizes the need for a safer seating position by placing the feet first. The reclining position also reduces frontal area therefore reducing wind resistance. Through the use of photographs I found the frontal area of each bike with rider and compared it to its highest speed achieved along with rideability and handling response.

THE PIEZOELECTRIC EFFECT: CRYSTALS WITH "CURRENT" VALUE

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Piezoelectricity is the unique phenomena of dielectric crystals which when under stress form a dipole movement (electrical polarity).

This project proposes that the stress may be electrical as well as mechanical. Substances which did and did not form dielectric crystals were identified and desired crystals cultured. The process of culturing crystals for testing was a challenging one. But the true challenge was to devise a means of perceiving the changes the crystal underwent when subjected to a pulsating electrical charge. The non-piezoelectric crystals may transmit a charge along the face(s) of the crystal but piezoelectric crystals appear, under the influence of a charge, to alter their structure and internall conduct the charge.

IMPROVING THE NATURAL GAS FURNACE AND HEAT EXCHANGER

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In order to see if the efficiency of a natural gas furnace could be improved, the temperature measurements of it were recorded. Then baffles and a secondary heat exchanger were added and the measurements were taken again to see if the efficiency had been improved. Two other experiments were run to see if the efficiency had been improved. In experiment number two, the temperature and weather conditions of each day were recorded and compared to the gas consumption of that day. In experiment number three, the house was tightly closed and the gas consumption for one hour was recorded. Then the house was opened up and the same measurements were taken again to compare to the first time. These three experiments were run to see if the average home-owner could effectively and cheaply cut the gas consumption for their home.

#DEVELOPMENT OF THE MULTIPLE PATH, IN LINE, AUTOMATIC GAIN CONTROL

Douma, Darin James, Harlingen H.S., Harlingen, TX 78550
1902 E. Washington #5, Harlingen, TX 78550

The common automatic gain control, or AGC, in use today has several limitations which make it impossible to use, or inefficient, in many applications. More range, power, and sensitivity are needed in dozens of situations - notably communications devices. A multiple path, swithcing AGC is a possible substitute, having none of the common AGC's limitations, but complexity and redundancy in design make this alternative expensive. There is, however, a configuration of the multiple path AGC, an in line version, which eliminates redundancy, and with it, expense.

The purpose of this project was to prove the engineering feasibility of a multiple path, in line AGC. In order to do this a design had to be developed from the ground up, constructed, and improved to the point of workability.

The general structure of the MPIL AGC developed here represents the end product of revisions on dozens of earlier configurations. After a basic structure for the device was determined, it was broken down into sub-processes and implemented electronically. The components of the switching system are entirely solid state, mostly in the form of integrated circuits. Again the design was revised several times until its requirements could be met by contemporary and inexpensive semiconductor technology.

The design represented here for an MPIL AGC is composed of discrete identical stages and thus expansion of the device is simply a matter of adding stages. An integrated circuit containing this device could reduce the cost of an AGC of this type to a few dollars and significantly improve the performance of many common electronic devices.

#Honorable Mention - United States Air Force

#A UNIQUE DESIGN FOR HARNESSING THE OCEAN SURF

Gully, Nathan L., Carden Heights School, Redding, CA 96002;
16556 Power Line Road, Redding, CA 96001.

My purpose was to construct a machine capable of producing usable power from the ocean surf. It consists of a multi-paddle assembly attached to a system of ratchets.

Four main steps were used in putting the project together. The first involved building two wood models, neither of which worked. The second step involved making blueprints for the final metal model, and the third step included building the model. Finally, I tested the model, made observations, and formulated conclusions.

From these observations, I have concluded that a full-scale machine following this design would work. During the test, a continuous motion was created. The period of time in which the flywheel continued spinning could have been increased considerably if all the shafts had precision roller or ball bearings. Due to the expense, they were omitted.

The efficiency could be increased greatly by enlarging the size of the ramp opening, increasing the weight of the flywheel, and increasing the height of the paddles for more leverage. In actual operation at full scale, some additions would be needed. First, the ramp should have a grille at the opening to keep out any debris or marine life. Second, a system would have to be developed to allow the machine to follow the tide up and down the beach on rails.

In conclusion, I believe there is a possibility that coastal communities could be furnished with a safe and economical source of electricity from this design without endangering the environment.

#Third Award - Marine Technology Society/U.S. Naval Institute

#CONSTRUCTION AND TESTING OF AN ACTIVE HOT WATER/METHANE PRODUCTION UNIT: USING SOLAR ENERGY AND ANIMAL WASTES.

Correll, J. Robert, St. Marys High School, 1002 Second Street,
St. Marys, WV 26170: Rt. 1 Box 222 Friendly, WV 26146.

Purpose/Application: To design, construct and test a system that utilizes solar energy and the biochemical processes of waste decomposition to increase methane produciton from animal wastes. Also, the excess heat is to be used for domestic water heating.

Hypothesis: Solar energy can be used to heat methane producing bacteria to their optimum temperature for methane producing duction, faster than they could with their own heat. This will increase the gas production. Excess heat can be stored and used for holding the temperature and for domestic hot water.

Procedure: This third design utilizes a trickle-down solar water heater, passive heat storage and heat exchangers to increase the temperature of animal wastes to the optimum level faster and hold it there. This will increase the production levels and efficiency.

Conclusions: At the present time I have the production time down to four days. Much work is still needed on storage and on the electronic and automatic control that I am constructing.

#Third Award - General Motors ISEF

INSULEN: EXPERIMENTAL CONTROL WITH A COMPUTER

Rowe, Alexander K., Walt Whitman H.S., Bethesda, MD.
5712 Aberdeen Road, Bethesda, MD 20814

For most high school students, the application of computers for biological research is limited to the analysis of data; experimentation is still manual labor. This project is meant to demonstrate the ability of a computer to not only gather data, but to actually control an entire experiment. The INSULEN (Insulated Environment) is a single-board microcomputer which has a dedicated function to operate an environmental chamber.

One example of the application of INSULEN is demonstrated in the experiment where two sets of plants are raised. The first group is grown in an atmosphere of carbon dioxide and the second group, the control, is grown in open air. All other variables are kept constant. INSULEN controls watering, length of day and night, the circulation fans, the temperature recording of the two chambers, and the production of a time lapse movie of the two week experiment.

INSULEN, and other computers like it, are new tools which can be implemented in experimental control. They are space efficient, often inexpensive and, most importantly, can reliably remove certain elements of human error as well as the elements of drudgery which are associated with long term experimentation.

#A STUDY OF SAIL PERFORMANCE THROUGH WIND TUNNEL TESTING

Bibb, Karen L., Melbourne High School, Melbourne FL 32901
567 S. Sonora Circle, Indialantic, FL 32903

This study is concerned with the depth and position of the maximum draft and their relationship to the power of a sail. The Florida Institute of Technology wind tunnel was used to evaluate 16 different sail shapes under varying wind velocities and angles of attack. The sections varied in draft depth and position. Draft depths ranged from 6% to 15% of the chord length, and draft positions from 25% to 55% back of the forefront of the section.

Lift and drag was measured for each section at wind speeds ranging from 5 to 35 miles per hour and at angles of attack from 0 to 35 degrees. Each section was tested three times, for a total of 2000 pairs of lift and drag values. The lift and drag coefficients for each angle of attack were calculated from the average lift and and drag values. The standard deviation for these lift and drag coefficients was also calculated. From the two coefficients, the resultant force coefficient was determined for each angle of attack using the formula: $Cr = Cl (\sin B) - Cd (\cos B)$. The resultant force is the force in a forward (B° off the wind) direction. The statistical range for each resultant force coefficient was also calculated, based on the deviation of the lift and drag.

The sections were compared on the basis of the range of the resultant coefficient. When the angle of the course sailed to the wind, B, is small, the flatter sails performed better. As B is increased, the fuller sails perform best. Presently, the velocity made good to windward is being studied to determine which sail will provide optimum performance under normal sailing applications.

#First Award - Marine Technology Society/U.S. Naval Institute
Second Award - General Motors ISEF

#EXPERIMENTING WITH ROBOT DESIGN AND CONSTRUCTION TECHNIQUES

Sargent,Eugene, Fayetteville H.S.,Fayetteville,Ark.72701
1775 Janice ave.,Fayetteville, Arkansas 72701

In the field of robotics there are many,many possibilities. I think a lot more experimentation should be done in this field.

The purpose of my project was to design and construct a robotic device and from this experience,learn as much as I could about robotics. I started the project knowing that I probably wouldn't make any major discoveries or technological breakthroughs. The materials available for the construction of the project were salvaged from surplus machines and computers. Construction was done with a very limited tool selection. Many parts were made by laborious hand work. Before starting construction of my project I had to design it. I wanted the robot to have a small, maneuverable chassis that could be updated later to carry "hands" and "eyes." The ultimate goal for the project is to interface it to a computer and experiment with programming.

I started on the construction with the chassis and gradually added on all the other systems. The senses were the most complicated and the most important systems. The senses I built into my project are: speed, distance, position of sterring column, drive motor current, and battery voltage. I have used a minimum of purchased parts because of limited funds. My construction techniques are fairly conventional using nuts and screws for the major joints and epoxy on the minor ones. As I built each system I made sure to test it thoroughly before proceeding to avoid problems later.

Even though my project is not yet completed, I have been able to show that it is possible for a high school student to design and construct a small experimental robot.

#Fourth Award - General Motors ISEF

CAPTURING THE WIND WITH WIND TURBINES

Van Dyke, Kurt D., Amos P. Gobdy H.S., Tallahassee, FL 32304
2412 Delgado Drive, Tallahassee, FL 32304

Remember the riddle, "what is it that you can feel but cannot hold in your hand"? The answer is, "the wind". And while it is true that you cannot hold on to the wind, it is possible to harness the energy that is within the wind -- with the use of a mechanical helper, a device known as a wind turbine.

Wind turbines...what do they do? How do they work? What sort of energy can this device extract? This project will explain and answer these questions by providing information on winds, testing sites, turbine and energy efficiency, and applications.

Is this energy source a practical one for the future?

A small working turbine is used to illustrate and test the many theories used. Test results provide sufficient evidence that the hypothesis is accurate in most respects.

#AN IMPROVED METHANE DIGESTER & METHANE POWERED ENGINE

Markey, Ray E., Jr., Dallastown Area H.S.,
Dallastown, PA 17313
2477 S. George Street, York, PA 17403

An Improved Methane Digester & Methane Powered Engine was exhibited with modifications made to the digester of a previous project.

An engine was modified to use methane gas as a fuel. This engine, drives an electrical generator. The possibility of using digested waste as a fertilizer was explored.

#First Award - U.S. Department of Energy
Third Award - General Motors ISEF

#DESIGN CHARACTERISTICS INFLUENCING WINDMILL POWER OUTLET

Brian Edelmon

Friona High School
Friona, Texas
79035

401 Oak
Friona, Texas
79035

Recent alteration developments in windmills have led to interest in windmill power output.

It is the purpose of this project to determine the optimum number of blades with corresponding angle to produce maximal power output.

Six blades were designed and formed in styrofoam. Tests were run by changing blade compliment and angle. RPM at predetermined torque loads were measured.

At twelve mph wind velocity, a 4° tip angle was determined to produce optimal power. With the same wind velocity, six blades were determined to have the highest power output.

After calculations, it was determined that a blade with a 7° twist to the midpoint and a 20° twist to the base would have had a uniform angle of attack throughout the blade.

#Alternate Award - U.S. Department of Energy

AN ORIGINAL INTEGRATED CIRCUIT

Olsen, Julie C., Davis H.S., Kaysville, UT 84037
125 W. 900 N., Farmington, UT 84025

The purpose of this science project is to determine whether a bright high school student, with a minimal knowledge of integrated circuits and electronics, can create and document the process of an original integrated circuit.

In order to gain a necessary amount of information I have read the first four chapters of UNDERSTANDING BASIC ELECTRONICS.

My original circuit will record the elapsed time of the first of four individual events from a given start time. It will also record the order of the finished events.

The project consists of a number of phases. The first phase of the experiment is the block diagram of necessary logic. The second phase is the design of each incremental circuit. The third phase is the prelimenary composite drawing. The fourth phase is the "bread-boarding" of each incremental circuit and testing it on the experimenter. The fifth phase is the construction of the circuit. Then marking any corrections in red and yellow, and the reasons for them.

I documented my whole procedure. I built the circuit and a runway with four marbles acting as events.

The circuits are made up of various different gates: AND, OR, NAND, NOR, INVERTER, and BUFFER. A list of these circuits are found in the electronics catalog. I had one circuit that was given to me and I created the rest.

#SAFE (Scanning Automatic Fire Extinguisher)

Turner, Marc L., Golden H.S., Golden, CO 80401
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A new fire control system was invented and developed which represents a significant advance over current fire-extinguishers. Project SAFE, an acronym for Scanning Automatic Fire Extinguisher, is a system designed to electronically detect, locate, target, and extinguish small flames before they become large. The system performs its functions automatically and inconspicuously from a small scanner installed in the ceiling. Upon detecting the infrared emissions of a small flame, SAFE electronically directs a targeted stream of fire-extinguishing agent toward the flame. After computing that the fire has been smothered, the system resumes scanning for new flames. Individual units may be programmed to "look over" constant heat sources such as fireplaces. Utilizing a heat-sensitive semiconductor diode, the device may be programmed to respond to various preset levels of heat emission, from a cigarette butt to a gasoline fire. In the future, a communications network between these stationary detectors and robot fire-fighting units could be built in, which would notify the mobile units of the fire's location.

The SAFE system has many applications other than fire-control. The heat-seeking device can be modified easily to form a sun-tracker for solar cells, a self-directing ballistic missile interceptor, and an astronomical vector-navigation system for spacecraft.

#First Award - General Motors ISEF
Third Award - Junior Engineering Technical Society
Honorable Mention - American Patent Law Association

SATELLITE T.V. - IS IT WORTH IT?

Eckhard Lutz
Highland Secondary School, Dundas, Ontario
R.R. # 1, Troy, Ontario. L0R 2B0
Canada

The purpose of my project was to design, construct and test a satellite T.V. receiver dish, with the objective of producing a good quality dish at an affordable cost.

In order to build the dish I had to first choose between a spherical and parabolic curve. Once I had chosen the parabolic curve, I wrote a computer program to generate the curve using 1/4 inch increments. A focal distance/diameter ratio of .375 was used to ensure good forward gain, yet eliminating the possible shadows from satellites, which may in the future be placed between already existing satellites.

The dish was formed by welding (Tungsten Inert Gas) precisely formed aircraft tubing and lined with # 8 wire mesh for the reflective surface.

After testing the precision of the curve by moving the focal point and observing picture quality, I compared the results to manufactured models.

At a cost of under $400.00 Canadian, my dish is superior and definitely worth it!

#DEVELOPMENT OF A COMPUTER CONTROLLED QUADRAPED VEHICLE

Jones, Sande R., Hattiesburg H.S., Hattiesburg MS, 39401
903 Sioux Lane, Hattiesburg, MS, 39401

The majority of land animals are quadrapeds, they use a form of locomotion which we call walking, this enables them to travel over rough or uneven terrain with ease. This project involves the study of some four legged animals and the integration of their walking gaits into a computer interfaced mechanical device which mimics or adapts these gaits for its own locomotion.

In many cases a walking vehicle will be more efficient than wheeled or tracked vehicles, because of the ability to step over objects and indentions in the terrain that it is traveling. These abilities make a walking vehicle ideally suited for applications such as agriculture, military vehicles, industry, and other similar uses.

The device that I have designed and constructed consists of a lightweight motorized body structure with both linear and digital sensors that feed back position information to the micro computer. The micro computer controls all aspects of movement, placement of the legs, and the static balance of the device. The computer controls the the servo system through a memory mapping system that allows a total access of 255 output ports. The data is transmitted over a ribbon cable in eight-bit parallel form. Inside the device the signal is decoded and the corresponding servo is activated.

#Second Award - BDM Corporation
Fourth Award - General Motors ISEF

ELECTRONIC CIRCUIT DESIGN WITH THE COMPUTER

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The basic methods of electronic device development have remained virtually unchanged since the early days of radio. Until a very short time ago, the design work involved required nearly eighty percent of development time. With the advent of the modern electronic computer, however, a new and incredibly powerful tool was placed at the disposal of the designer. The computer can be programmed to make all the necessary calculations to design entire circuits when fed the parameters of the active devices to be used. The finished prototype can be connected to the I/O ports of the computer via a simple interface, and all operating data such as amplification, noise figure, etc. is displayed on a video monitor screen. Computerized circuit design does not require a multi-million dollar computer system. All of my programs were written on a 48K Apple II Plus system, and they are advanced enough to handle many complex design problems. There is no reason why even the most advanced circuit analysis and design problems cannot be solved with the computer. The potentials of the computer are limited only by the ability of the programmer.

BEHAVOIR OF A BOLTED LAYERED BEAM SYSTEM

Gessler, Daniel, Poudre H.S. Fort Collins, Colo. 80521
3205 Shore Rd. Fort Collins, Colo. 80524

My objective was to test a layered beam system which could be produced on location. In this investigation I used screwed layered beam systems with evenly distributed bolts to bond the beams. It can be assumed that the number of bolts, the torque which is applied to the bolts, and the load control the deflections of such beams. In this investigation of small deflections these papameters are varied systematically and the results compared with those of a glued beam system, and a beam system without connectors. It was found that a bolted beam could be made as rigid as a glued beam.

COMPUTER ANALYSIS OF DIRECT CURRENT ELECTRONIC CIRCUITS

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The study of Direct Current Electronics can be enhanced through the use of a computer to analyze and display any user-defined circuit, thus creating a learning experience, or an initial tool for testing a circuit before construction.

The purpose of this study was to develop a computer program for the Apple II computer that simulates and analyzes any simple Direct Current circuit.

The program has been developed so that the user inputs the circuit in the form of a string variable, the total voltage, and the resistance values for each component. The computer then analyzes the circuit from the innermost set of parenthesis outward, finding the equivalence resistance of the circuit and calculating the total current.

The program then makes use of Kirchoff's voltage and current laws to calculate the current, voltage and power for each component.

THE HELPING HAND

Rapp, David A., Wheeling Park H.S., Wheeling, WV 26003
763 National Rd., Wheeling, WV 26003

The objective of this project was to design a solid-state controller to automate machinery presently in use, so that modernization of plants could be accomplished efficiently and economically. The solid-state circuitry would provide low maintenance cost. Many months of research, experimentation and construction were done before a design was completed to control up to four motors with two directions and two speeds.

The controller uses fifty integrated circuits, thirty-nine of which are on four main boards. Eleven other integrated circuits are used in the power supply and solid-state switching circuits.

In order to demonstrate the controller, a robotic arm was constructed. The optic sensor on the arm furnishes data from the motors on the arm to the controller. Then this data is fed into a counter and the counter's data is compared with the RAMs' data. The result tells the motors which way to go and at what speed. The four RAMs are the main memory devices. This gives the controller the capability of being programmed with a program as long as 1,024 steps or with numerous small programs. One step would consist of a motor moving from an old position to a new position.

Accessories can be added to the controller. Its memory can be expanded to use a permanent memory such as a ROM (Read Only Memory) so that permanent programs, such as cartridges, can be made and inserted, or it can be adapted to read computer cards.

The conclusion is that an economical modernization of existing machinery is feasible.

DESIGN AND CONSCRUCTION OF A ROBOTIC ARM

Troche, Edmund, Academia Inmaculada Concepción, Mayaguez, P.R. 00708;
Andalucía #111, Res. Sultana, Mayaguez, P. R. 00708.

The objective was to design and construct a mechanical arm to duplicated the movements of a human arm.

The forearm and upper arm each consist of two parallel mounted 1/4" diameter stainless steel rods connected by 3/8" diameter steel rods mounted crosswise. A high torque motor, connected into a wood-acrylic-aluminium box, represents the shoulder and rotates the arm shoulder axis via helical tooth bevel gears. The axis is bearing mounted.

The elbow consists of two aluminium plates connected like hinges, and a high speed motor of 34 inch-ounces that produces the elbow movement. This motor rotates a threaded rod via gears. As it rotates, it moves a bolt that is connected by a bar to the upper part of the forearm up and down, and makes it possible for the arm to contract up to 90° and extend to 180°. Two limit switches limit the travel of the bar.

The end efector has two parallel plates that close with a solenoid to hold objects. This solenoid is mounted in the upper part of the forearm and connected via a cord to the end efector.

A wrist effect is given to the end efector by a stepper motor whose rotation is at $.9^{\circ}$ (each step). This motor gives the roll degree of movement to the arm.

The arm can lift 130 grams by the end efector and up to 3 lbs. if the object is dangled from the wrist section.

AN 8-BIT DIGITAL/ANALOG CONVERTER

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4483 S. Section Line Rd., Delaware, OH 43015

Before digital computers can be used to control devices such as motors which require continuously varying analog signals, an interface between the digital output of the computer and the analog input of the motor is needed. This project uses a Digital-to-Analog Integrated Circuit (DAC IC) chip to convert the binary voltage signals from a computer parallel output port to the analog voltage signal required to drive a servomechanism. The servomechanism is used to position a model antenna, which can be automatically driven or positioned by the computer.

The servomechanism compares the analog voltage input to a feedback voltage from a potentiometer attached to the antenna, which indicates antenna position. The servomotor then rotates the antenna until the feedback voltage equals the analog input voltage. When the feedback voltage from the antenna potentiometer and the analog input voltage from the DAC are equal, the antenna has been positioned properly by the analog input signal.

The software (programs) written for the computer permit a variety of control options. By determining the relationship between the antenna position in degrees and the binary input to the DAC, computer programs can be written to scan the antenna with any desired motion or move it to any desired position.

#SIR, A COMPUTER CONTROLLED INDUSTRIAL ROBOT

Churchill, Thomas J., Macomb H.S., Macomb IL 61455;
166-B James Drive, Macomb, IL 61455

PURPOSE:

The purpose of this project was to design and construct a computer controlled industrial robot capable for use in factory automation and to create a high level computer language to control the robot's movements.

PROCEDURE:

SIR (Small Industrial Robot) was built using the materials and methods described in this paper. A complete listing of the controlling language, CRL (Computer to Robot Language) is included as well. Experimentation, testing and debugging played a major role in the developement of both the robot and the controlling language. Among the numerous materials used were: an oscilliscope, integrated circuits, a home computer and various A.C. motors.

CONCLUSION:

With the completion of SIR and CRL, I can conclude that, as an industrial robot, SIR fulfills many of the requirements needed in order to play an important part in reprogrammable factory automation. Tomorrow's "factory of the future" begins with today's experimentation- this has been my attempt to produce a practical prototype and gain knowledge in a new and exciting field.

#First Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Fourth Award - General Motors ISEF

#LATERAL DIRECTIONAL SYSTEM

Mc Gushion,Kevin D., Okeechobee H.S., Okeechobee, Fl. 33472
309 N.W. 12th Ave. Okeechobee, Fl. 33472

Since the developement of hovercrafts, they have been inefficient and uncontrollable. these two factors have hindered commercial and practicle developement of hovercrafts. Existance of these problems have made operation of a hovercraft both costly and dangerous.

This research is concerned mostly with the improvement of maneuvring. In developing a system three objectives must be kept in mind:

1. Make a device to cancel out coasting after turn has been made.

2. Make a device which will be able to deliver more usable thrust.

3. Do the above with an acceptable amount of power increase or decrease.

Primary research was done with a model hovercraft powered by a vaccum cleaner engine. Existing maneuvering systems and it's variations were tested. New systems were tested evaluated and compared to the existing systems.

After extensive testing a prototype was achieved which met the design objectives. This system was variations of the lateral directional system. It delivered more usable thrust and provided a more efficient reaction. It was overall 66.8% more efficient than the common verticle rear mounted propeller.

#First Award - General Motors Corporation
First Award - United States Navy

#AN INTELLIGENT SOLAR COLLECTOR PHASE II: THE SUN SEEKING SYSTEM

Warman, Craig R., Jefferson Forest H.S.
Forest, VA 24551;
104 Old Forge Place, Forest, VA 24551.

The goal of this project is to interface a computer with a parabolic solar collector. The collector can be moved at calculated times during the day. To provide power for collector movement, the computer is interfaced with a motor that has a solenoid-operated forward/reverse gearing system. The collector dish is moved into each of five positions during the day based on sunrise and sunset times. This allows the collector to "follow" the sun's path across the sky so that it receives direct sunlight throughout the entire day.

While the system is in operation, the computer uses a light sensor mounted on the collector plate to take light readings each minute. The average of these readings is graphed by the computer every quarter hour. Comparative analysis of these readings shows that sunlight collection increases 67% when the system is used in the sunlight seeking mode than when set up in a fixed collector fashion. On partly cloudy days the sunlight seeking mode increases sunlight collection by 33% over that of the fixed collector mode.

#Alternate Award - U.S. Department of Energy

AREODYNAMICS IN THE APPLICATION OF SAFETY IN HOME BUILT AIRCRAFT

Clapp, Chris G., Allegany Central School, Allegany, N.Y. 14706;
Box 237, RD # 2, Smith Hollow Road, Allegany, N.Y. 14706.

The objective of the project was to develop for the home builder of airplanes, an inexpensive but accurate method of designing wing sections and checking their efficiency and safety.

A wind tunnel 47½" long and 6½" wide, constructed of mahogany and sheet metal and powered with an induced draft fan of fractional horsepower to develop a constant wind speed of 200 fpm was used to test five computer-designed wing sections of soft pine, machined to scale, and mounted on a pivot to assume variable angles of attack. A steady smoke stream was then introduced to make the airflow patterns of each of the five wing sections visible at their stall points for recording on video tape.

A computer program, consisting of graphs on which were plotted the life and drag of each wing section , was used to confirm the stall points of the wing sections as observed on the wind tunnel and to develop by interpolation more specific results.

All stall points as determined by the wind tunnel were confirmed to within 1° of angle of attack, using a Reynolds factor of 6 as a constant.

The methods and calculations provide an accurate and efficient means of designing wing sections to suit individual flight and safety requirements of home builders.

#DUAL CHAMBER HEAT STORAGE SOLAR AIR PANEL

Fuller,Gregory J.,Buchholz H.S., Gainesville, Fl. 32601
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Solar air heating is a relatively new concept developed within the last few years. Solar air heating is a spin-off of solar water heating and uses the same principles. The first type of solar air heating system was a water-to-air heat exchanger, but the system required hotter water than the panels could ever provide. The next type of solar heating system was a passive system that involved the sun heating a plate that heated the air passing around obstructions mounted to the plate. This worked during the day, but to store heat for use during the night would require a gravel chamber 2/3 the size of the building or house to be heated.

To this problem I have designed a new type of solar air heating system. The panel incorporates both the absorbtion and storage materials. The panel is divided into upper and lower chambers by a steel plate. Through this plate are copper tubes which connect the upper and lower chambers. During the day, the plate is warmed by the sun. Air is forced into the upper chamber by a fan and through the tubes where it is heated. Then the air passes into the building as heated air. Tiles are mounted to the bottom of the plate and absorb the heat for use at night. During the night air passes only through the lower chamber where the tiles give off the heat stored providing the needed heat. The system on an average day produces heated air from 80 to 120 degrees and stores the energy for 10 to 15 hours until needed. When heat is needed the system can produce heat for 8 to 10 hours. This system is very small and costs less than the systems produced today.The unit performs at maximum capacity absorbing and storing heat sufficently for use through the winter.

#First Award - National Aeronautics and Space Administration

COMPUTER CONTROLLED ROBOT

Smith, David C., Davenport West High, Davenport,IA 52806
2510 W. 56 St., Davenport,IA 52806

The primary goal of this project is to give the computer the ability to do physical labor by interfacing the computer to an external motorized device. The external device in this project is a robot crane designed to do light duty moving and/or stacking of objects. The robot consists of a light weight steel frame mounted on a turnable surface. The interface board was designed and built to control two bi-directional motors and have one on/off control of any device ranging from an electro-magnet to warning lights. The interface has designed into it, circuits to monitor any position change in the robot and give this data to computer upon request. The interface also has auto shut-off capabilities; when given drive, direction and position data from computer, it will move crane to position specified and will shut off drive to motor(s) thus stopping robot in the specified position. The computer used in this project is a TRS-80 Model 1. The control program allows for single key entry of instructions. Up to 500 steps can be entered and stored in computer. The computer will remember each step and can re-execute these steps on command. With this, you can teach the computer what to do, and the computer can do it again and again. The system (ROBOT/INTERFACE) is still in the design stages and has taken six months to reach its present level of completion.

#RESEARCH AND DEVELOPMENT OF A MULTIPROCESSOR Z80A BASED MICROCOMPUTER FOR THE STD-BUS

Voss, Timothy A., Cocoa H.S., Cocoa, FL 32922;
2453 Diane Dr., Cocoa, FL 32922.

The STD-Bus is a set of specifications defining the signal flow among compatible computer boards. It is widely used throughout industry for control applications, but it is limited to 8 bit microprocessors.

The purpose of this project was to develop a low cost, high performance STD-Bus computer system. It was hypthesized that multiprocessing, using more than one central processing unit, could be cost effectively applied to the STD-Bus. The architecture of this computer is based on a modified crossbar switching system of my own design. The master and slave processors communicate through a shared section of memory. A redundant memory map technique was used to increase software data movement by a factor of 2.

The computer is composed of a master processor board, a master memory board, and 4 slave processor boards. I chose to use the Z80A microprocessor because of its speed, large instruction set, and automatic dynamic RAM refresh. This computer has 128K bytes of RAM, 48K bytes of ROM, and a color graphic video display. I prototyped this computer on STD-Bus wire wrap boards.

In conclusion, the objectives of this project were met as the computer is 93.3 percent efficient. This computer has a cost increase of 54.6 percent and a processing power increase of 393 percent over that of a single processor STD-Bus computer. This computer is very cost effective: it has a cost per instruction decrease of 68 percent.

#Second Award - General Motors ISEF
Third Award - IEEE Computer Society

#ELECTROMAGNETIC PROPULSION

Olson, David F., Eveleth High School, Eveleth, Mn. 55734
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A search is on for a better space launching system. The push is toward developing electromagnetic methods of accelerating and launching projectiles. Electromagnetic launchers which use electric and magnetic fields to propel projectiles are feasible in the near future.

The purpose of this project is to study the principles of electromagnetic propulsion and to investigate the potential use of electromagnetic space launchers.

The first step in this project was to gather information to gain an understanding of the magnetic phenomena dealing with electromagnetic propulsion. Then I built a demonstration model of a repulsion coil to further my understanding of the principles involved. Experiments were conducted with this coil demonstrating magnetic repulsion, levitation, and electromagnetic induction. These principles are applicable to various aspects of electromagnetic propulsion.

My next approach was to further extend and apply these principles to electromagnetic space launchers. I am presently designing a prototype of a future electromagnetic space launcher for the purpose of propelling payloads and satellites into space.

The experiments conducted in this project indicate that the force from a magnetic field can levitate a payload and propel it at high speeds. Modern power sources seem capable or have the potential of being capable of providing the necessary current. Many electromagnetic launching systems are presently in the experimental stage. New electromagnetic launchers could have far-reaching impacts, and become an economical tool for space exploration in the future. This is an exciting technology with great potential.

#Honorable Mention - National Aeronautics and Space Administration

#INCREASED AIRCRAFT SAFETY THROUGH THE USE OF ROTATIONAL CANARDS

Gehrett, Rodney, Greenville H.S., Greenville, MS 28701;
1761 Camellia Dr., Greenville, MS 38701

This project attempts to devise a way of increasing aircraft maneuverability and safety while at the same time decreasing production cost. This is done by using a new rotational canard wing, which is of my own design, along with leading edge flaps.

The rotational canard wing is much like any other canard wing, with the exception of the X-axis spin. This spin, along with the canard wing flaps, controls the entire aircraft; therefore eliminating the need for ailerons and vertical flaps.

Another new feature of the designed aircraft is the leading edge flap. This flap is intended to be lowered into the relative wind during landing, thus establishing boundary layer attachment to the wing. This would allow slower landing speeds with less chance of a stall.

After a preliminary design was made, a water tunnel was built and tests were conducted on the model and several wing sections. The testing proved that the rotational canard could be used to control aircraft, thus increasing safety while insuring quicker response to the pilot's actions.

#First Award - International Aerospace Hall of Fame

COMMUNICATING WITH A COMPUTER: METHODS OF INTERFACING PERIPHERALS

Clough, Scott J., John Marshall H.S., Rochester, MN 55901;
R1, Zumbro Falls, MN 55991.

The purpose of this project is to find the best way for computers and their peripherals to communicate by means of illustrating several contemporary interfacing methods. Some of these methods are: Port I/O, Memory Mapping, and Direct Memory Access.

Initially, my computer was designed exclusively with port I/O. However, in port I/O, all of the lines go to the same chip, and, when additional devices are added, noise problems develop. In a successful attempt to solve the problem, I converted to memory mapping. In single user environments, memory mapping usually works best.

Normally, in order to transfer data from a peripheral to memory or vice versa, the data would have to go through the microprocessor. Direct memory access controllers greatly speed up data acquisition because they allow bypassing of the CPU. The two most popular types of DMA are continuous and transparent. In the continuous mode, the device locks the CPU out of the bus for the duration of the time that the device needs access. There are disadvantages to this, such as if the CPU is in a timing loop. DMA may cause the timing to be off, perhaps causing incorrect data to be written on tape or disk. Transparent mode is better because the device only gets data when the processor is not using the bus. For example, in the 6800 series devices, a CRT controller could use the bus every other transition of the clock.

After interfacing several devices to my computer, I have found the best way of interfacing depends upon the devices involved.

#WIND POWERED GENERATOR PHASE II; DETERMINING THE OPTIMUM BLADE DESIGN

Knight, Arlin, Union Jr. High, 5656 S. 129 E. Ave., Tulsa Ok. 74134
5026 S. 91 E. Ave., Tulsa Ok. 74145

Determining the correct blade angle and blade design are two basic problems of developing a wind powered generator.

The first step was to build a test model. It was constructed in such a manner that would allow the test blades to be turned to different angles for testing. These blades, used to test blade angle, were of a rectangle shape 2" x 18" and had a airfoil design.

Wind to drive the windmill was provided by a portable box fan. This fan produced a constant wind source and is easily controlled.

After tests were conducted, from 0° blade angle to 40° angle, the conclusion was reached that a 5° blade angle produced the most R.P.M.

The second step involved blade design, that is the physical shape of the blades and their construction.

Five basic shapes were chosen to be tested, from a small 9" x 6" to one that was 2" x 27" or a total diameter of 60". Each of the blades were tested at a 5° blade angle and the results were analyzed, the conclusion was reached that the long thin, 2" x 27", blade proved, not the highest R.P.M., which was reached by the small, 9" x 6", blade, but rather the most constant R.P.M. over three test runs.

Mathmatical analysis are being tested to provide support to the conclusion establish by earlier testing, that is a long thin blade set at a 5° blade angle will be most efficient blade for a wind powered generator.

#Second Award - Bureau of Reclamation/U.S. Department of the Interior

#ELECTRONIC CONTROL OF THE PREPARATION OF GAS CILINDERS

Franz, Rikard, PAULISCHOOL, Malmoe
Befälsgatan 7 , 21233 Malmoe , Sweden.

An enterprise asked me to construct and build a control unit to a process containing 4 moments and 3 of these are repeated in 3 periods. The condition was that I should solve the problem to an amount that was 60 per cent below the cost of a small computer unit on the market.

The system is constructed by 12 CMOS integrated circuits and 3 timer-circuits (555). To drive the relays and the lamps I use ordinary transistors. To invent and build the control unit took approximately 2 months.

The system contains partly a power unit (12 V/400 mA) and partly a control unit and a relay unit. The consumption is 100 mA which means that the preparation plant can run for 24 hours. The control unit consists of one "CPU" as a 4017 path (a path who counts between 0-9) and other logic paths who trigger, control, start and stop the different timers. In the control unit there are 3 timers. The first one is changeable between 0-20 minuts, the second for 1,5 hours and the third between 1-19 hours. The system functions and is used in practice today.

#Second Award - Patent Trademark Office/U.S./Department of Commerce/
Patent Office Society
Third Award - General Motors ISEF

DEVELOPING A BIOPHOTOLYTIC GAS PRODUCTION SYSTEM VIA *Anabaena cylindrica*

#Longenecker, Steve, James Whitcomb Riley H.S., South Bend IN 46613
1510 Renfrew Drive, South Bend, IN 46614

Hydrogen has long been considered an ideal energy source because of its clean combustion and nearly unlimited quantity. Electrolysis and most other methods of hydrogen production are much too expensive for our present economy, however, the process of biophotolysis offers an inexpensive approach. Biophotolysis is the simultaneous production of H_2 and O_2 gases through the photosynthetic process. Basically, H_2 can be released from blue-green algae by blocking the metabolic process of nitrogen fixation with enzyme inhibitors or by placing the algae in a nitrogen free environment. This system, however, is not without certain presently insolvable generating problems. These problem areas include algal clumping, pH changes, filament breakage with associated overall decrease in cellular metabolism.

I first worked with the problem area of undesirable pH changes by daily adjusting the pH of the medium to the original 7.8. This resulted in significant increases in both rate and total H_2 production($p<0.01$) as compared to the control. The addition of glutamine(3umol/L) apparently replaced the unsynthesized amino acid in the heterocysts or at least allowed for the necessary metabolic processes to continue longer than those in the control cultures. This also produced significantly larger amounts of H_2 gas.

Both the adjusted pH medium and the supplementation with glutamine increased the H_2 output in the generators. However, the filament breakage problem persisted and ultimately resulted in the degeneration of the gas producing process. A glass bead support system was next introduced to reduce physical breakage of the filaments. The generators remained active for up to 3 weeks, at which time the series was terminated. Compared to the agitated groups these immobile cultures produced significantly lower daily rates of H_2 production($p<0.01$) but significantly greater total quantities of H_2($p<0.01$). The efficiency levels tended to parallel those of other researchers at about 0.2-0.8%.

It seems unlikely that the biophotolytic production of hydrogen will ever be a major energy source, however, as a supplemental, alternate fuel it merits additional research. In addition to fuel production, such a system could also be included in a closed space capsule and serve as a source of food and oxygen.

#First Award - U.S. Department of Energy
Fourth Award - General Motors ISEF

#SPECTRAL PHOTOVOLTAICS

Squires, Burton J., Osbourn H.S., Manassas, VA 22110
8906 Weems Rd., Manassas, VA 22110

The purpose of this experiment is to show, by experimenting and planning, that spectral photovoltaics is a feasible source of power generation.

The first step to this project was to gather a wide source of information which is essential to provide an accurate and up to date feasibility study. This information consisted of library information, graduating to more difficult to obtain information -- such as the conversation I had with the Chairman of Getty Oil, Sidney R. Peterson, on his company's direction and research toward photovoltaics.

Once the basic information was obtained, I built a demonstration model, which determined many things useful in my plans. Examples of such are: degrees in which to face array panels, number of square feet needed, and to estimate the overall performance of the spectral photovoltaic cell.

After these facts were determined, I started my work on my drafting plans, detailed to such an extent that an engineering firm could implement the project. Engineering this project proved that spectral photovoltaics for Manassas, Virginia is practical and thus feasible. Also, to give a better understanding of the systems design, I constructed a scale model to convey what was drawn on the plans.

By doing this project, I have concluded that spectral photovoltaics for Manassas is feasible on a large scale. In careful estimation, this system will produce about 3000 kw hours of electricity on prime days of insolation. It will have a payback in less than two years with a 30 year life. In its lifetime it will net the city over 40,000,000 dollars of "free" energy after system payback. My future plans are to present this idea to the City Council for further study and development.

#Honorable Mention - National Aeronautics and Space Administration

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#SPOIL THE 'FOIL: AERODYNAMICAL MODIFICATIONS OF AN ESTABLISHED AIRFOIL

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The purpose of this research was to test and study the effectiveness of a spoiler and/or an 'hourglass' shape on the aerodynamics of an airfoil. I believe my original designs would reduce drag, thus creating a cleaner, more efficient aerodynamic design/shape.

Model airfoils were constructed from sheet wood and finished for a smooth water tight surface. The airfoils were then tested on a waterflow plate, designed and constructed to simulate airflow. This simulation of air-flow became visible with the addition of a dark dye at five predetermined strategic points along the airfoil models to test flow patterns around the airfoil models. The results were photographed and studied.

Following experimental testing of the models, results indicated that a spoiler on an airfoil reduces drag, and produced greater reductions in drag when incorporated with these modifications--the slight 'hourglass' shape. The 'hourglass' shape alone, however, does not produce any advantage in obtaining a more streamlined or efficient model than a standard shaped airfoil. Improved validity may be attained through a phase II experimentation of actual scale-model construction of craft possessing these modified foils followed by in-depth flight testing.

#First Award - Eastman Kodak Company
Honorable Mention - Society of Photographic Scientists and Engineers

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ROMM II: REMOTELY OPERATED MECHANICAL MANIPULATOR

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The objective of ROMM II was to design and construct an industrial robot compatible with almost any computer. Having begun in 1980, ROMM II is actually a compilation of three years of study.

The first year ROMM I was produced. It was a simple manipulator with four main functions, yet it provided the foundation for a building process. ROMM I was enclosed in a simulated hot cell and designed to handle harmful or radioactive materials. ROMM I'S functions were vertical rotation, pivot, slide and clamp.

The second year, a science project on this subject was not submitted. Instead, the time was spent learning more about robots, finding more sources of information and actually seeing an industrial robot work and perform.

The third year was the final building process. The method of research used in designing ROMM II was simply trial and error. Design changes were drastic. One prototype could take anywhere from 8 to 10 weeks to complete. Thankfully the third change was successful.

ROMM II, in it's third prototype, is correctly wired to be interfaced with almost any computer. All of ROMM II's power requirements aee supplied by the AC Power Control Unit connected to RoMM II. ROMM II can be considered a success because robotics is a growing and complicated field of study and infomation on the subject is difficult to find.

WHICH BRAKE BLOCKS STOP A BICYCLE IN THE SHORTEST DISTANCE?

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The purpose of this project is to find which brand among a selected group of brake blocks stops a bicycle in the shortest distance under wet and dry conditions.

The bicycle was ridden at equal speeds in each trial toward a stopping line where the front brakes were applied, always with an equal force. The stopping distance was then taken from the front axle of the bicycle to the stopping line. This was repeated three times. Water was then applied in equal amounts in each trial to the front rim. Then the stopping distance with the wet rim was determined as was the stopping distance dry. This entire procedure was repeated with each brake block.

I hoped to find out several things: how do brake blocks with grooves compare to those with solid faces, especially when wet, and which of all the brake blocks stops the bicycle in the shortest distance. I predicted the solid face blocks would brake better than those with grooves. Also that the Mathauser C blocks would be the best overall block.

My final findings show that the grooved blocks stop better than solid faced blocks, even when dry. The Japanese copy of the Weinmann brake block had the best overall rating and best stopping distance wet. I would suggest this block to prospective brake block buyers.

#Effect of Wind Shear Upon a Wing

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PURPOSE: To determine how different types of wind shear affect wing performance in flight and air flow around a wing. Performance means (a) lift or lift factor (Cl) and (b) wing stability. Until recently, wind shear has not been well defined in fluid mechanics. Research in this area has been initiated because of recent airline crashes.

EXPERIMENTAL METHODS: A wind tunnel was constructed with a test chamber designed for this purpose. The wing is attached to a force transducer made with four strain gauges. The strain gauges' output voltage was recorded on a strip chart recorder and an oscilloscope (to measure wing stability). Once the transducer was calibrated, the following equaion was used to compute lift coefficient: Cl = 2L/psVV, where L = lift in dynes, p = density of air in g/(cm)(cm)(cm), s = wing's area in (cm)(cm), and V = wind velocity in cm/sec and refers to the main stream of air.

RESULTS AND CONCLUSIONS: At low wind velocities without wind shear the wing was stable. With wind shear applied to the leading edge of the wing, lift was gained but stability decreased substantially. At higher velocities once wind shear was introduced, the wing lost lift. When wind shear was applied to the middle of the wing, the wing always lost lift and stability. At low wind velocities lift becomes always negative. Air flow was observed by using dry ice, indicating what seemed to be a region of low pressure under the wing. This might be the reason for loss of lift.

#Honorable Mention - National Aeronautics and Space Administration

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#RICE IS NICE FOR THE HOUSE OF HULLS

Coburn, Chelby Ann, Washington School, Greenville, Ms., 38701
619 Wildwood Rd., Greenville, Ms., 38701

The purpose of this research was to refabricate and test rice hull bricks in comparison to clay and sawdust bricks. Rice hull bricks are based on the principle of substituting rice hulls for 26% of the clay in common clay bricks. When baked in a kiln, the rice hulls burn out, leaving a small amount of ash in air pockets throughout the brick. This results in a lightweight, insulating brick. Since the rice hull brick is lighter weight than the clay brick, it is possible to transport 2,000 more bricks on a shipment than the clay bricks. This establishes an economical factor for the transporter as well as the buyer. It has a tensile strength of 1,100 lbs./sq.in. It was found that rice hullbricks are more pliable than clay bricks, can be cut with an ordinary handsaw, can take and hold nails or screws as well as lumber and are highly fireproof. In an overall view, the rice hull bricks are more economical and practical than clay or sawdust bricks. The properties of the rice hull brick, both in abrasive-wear characteristics and in crack-resistance, added to its exceptional insulation properties, would make it a worldwide success. Their best use would be for the building and lining of kilns and fireplaces. The use of rice hulls as an additive to bricks warrants further research, especially in areas where rice hulls are plentiful.

#First Award - General Motors ISEF
First Award - Society of Women Engineers

#METHANE PRODUCTION IN A HOME SIZED DIGESTOR USING COW MANURE

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The production of complementary energy to substitute for coal and petroleum, which are so limited and non-renewable, constitutes one of the greatest concerns during these "Energy Crisis Days."

A new source of energy that can help solve this crisis is the biogas produced in an anaerobic digestor that can be so rudimentary as to be usable in a home. The digestor is a closed tank to which you introduce bio-degradable material at intervals producing volatile substances and weak acids. Temperature, pH, and rate of introduction of biodegradables are important variables. The decomposition is a four-step process by several anaerobic bacteria growing on manure.

The digestor has five openings fitted with tubes of different sizes. This is fed daily with manure at a specific time. The same amount deposited is eliminated as residue through a pipe located at the bottom of the biomass inside the tank. The whole decomposition process takes from two weeks to a month.

Chromatographic analysis and an anaerobic study indicated that methane gas and carbon dioxide were produced using cow manure as biomass.

Through this rudimentary technique you can produce in a simple apparatus methane gas which can be used for stoves, automobiles and production of electricity and cause a great improvement in the energy panorama. The residuum product from the digested manure can be used as a valuable fertilizer.

#Fourth Award - General Motors ISEF

#BASIC LIFT PRINCIPLES AS APPLIED TO MODERN ROAD VEHICLES FOR INCREASED FUEL ECONOMY

Johnson, James L., Goose Creek High School, Goose Creek, S.C. 29445
104 Dennis Drive, Goose Creek, S.C. 29445

Finding a solution to increase energy efficiency of road vehicles may be found in new concepts in aerodynamics. A design which would permit the vehicle to appear "lighter" as it's speed is increased, therefore decreasing the friction with the ground surface without too much loss of stability.

First, a wind tunnel capable of simulating highway road conditions and providing accurate measurements of lift and drag, as well as a smoke chamber to make airflow visual, was constructed. Then, a series of balsa wood and clay models with interchangeable components were tested, and the data was collected and analyzed. The models were focused mainly on variations of a low pressure spillover and the slotted air-foil design, as applied to automobile body designs.

Final conclusion. The concepts tested herein can increase fuel economy by 39 percent if applied to an automobile at 50 mph. A 22 percent increase comes from a lift generated of 8.3 hp. (630 kg of lift; 1 to 22 scale). A 17 percent increase resulted from the lowered drag co-efficient of the design (C_D .29). However, the design would not be stable at excessive speeds or adverse road conditions, due to the lift.

#Third Award - General Motors ISEF
Honorable Mention - Gulf Oil Corporation
Alternate Award - U.S. Department of Energy

#SEGMENTED MAGLEV PROPULSION RAILGUNS

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A systematical approach to increasing magnetic flux densities of various designs of railguns was investigated. A simple railgun accelerator was constructed. Experiments carried out on this accelerator revealed the average velocity to be 1.92 ft./sec. ± .01 sec. The next approach was the use of circular coils about the two main rails which produced counter fields and, subsequently, no acceleration. The third stage involved the use of supplementary rails lying beneath the main rails. The data from this accelerator revealed an increase of efficiency by a factor of 2.

By segmenting the supplementary rails it seemed possible to increase its efficiency. From various experiments employing this new design the following conclusions were made: (1) the velocity was tripled when the same power imput as that of the simple accelerator was used, (2) the self inductance of the accelerator was increased, and (3) a smoother ride was produced with a lower number of juncture breaks.

It should be noted when the current curve was at a higher peak and the voltage was at a lower peak, the acceleration was increased greatly.

#First Award - General Motors Corporation
First Award - United States Air Force
Third Award - General Motors ISEF

THE COMPARISON OF WEIGHT AND STRENGTH ON TRUSS AND SUSPENSION BRIDGES

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Arundel Junior High School, Odenton, MD 21113
2514 Symphony Lane, Gambrills, MD 21054

The main objective of this project was to study the structural properties and characteristics of a suspension bridge as compared to a truss bridge. To make the tests valid, the bridges were built to the same length and width, and they were made of the same material-balsa wood. To further control the experiments, the weights of the two structures were compared.

The two bridges were evaluated separately as to the amount of weight each could support without breaking. The bridges were tested in a two-phase operation:

(1) Weights, in graduations of 100 grams, were divided between the three base supporting beams.

(2) Weights were suspended in 100 gram graduations from a metal plate which evenly distributed the weight across the entire length of the bridge. In theory, this method should allow the bridge to hold more weight than with the first method.

These tests on the bridges generated data which were graphed and evaluated.

As anticipated from research, the suspension bridge and the truss bridge were found to be capable of supporting equal amounts of weight.

#AUDIO INTERFACE DEVICE FOR COMPUTER AIDED INSTRUCTION

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6300 Windwood Dr., Kokomo, IN 46901

The purpose of this project was to design and build a complete, programmable system for orally and visually presented computer aided instruction. The system had to be reliable and easily managed by school children.

A digital interface was designed and built for the project, enabling a TRS-80 computer to control the input, output and power of five standard cassette tape recorders. The CTR's provided a simple and inexpensive method of recording audio messages. A single microphone and speaker were used by all CTR's with the computer controlling the multiplexing through the interface. In addition, the interface allowed student responses to be entered from a remote input device. Over 30K of BASIC and machine language programming were written for AID-CAI.

To test its applications, AID-CAI was placed in a 5th-grade classroom. Although the system could administer almost any type of test, spelling and multiple choice tests were implemented. The teacher recorded oral messages to present questions and to make comments on correct and incorrect answers. These messages were then selectively played back to the student while he was taking a test. A machine language timing program and a series of BASIC data-base programs controlled whether messages were played or merely advanced over.

The subjective results of the classroom trial were very positive. In a questionnaire, the students and teacher reported the system very helpful and enjoyable. The hardware performed reliably and the software made the system easy to use. The project shows that an AID-CAI system was very feasible and, furthermore, that it could be a highly useful addition to the learning environment of a classroom.

#Second Award - General Motors ISEF

DETERMINATION OF THE GEARING SEQUENCE, WORK DONE, AND EFFICIENCY OF A TEN-SPEED BICYCLE

Simon, Kent D., Auburn H.S., Auburn, AL 36830;
431 Scott St., Auburn, AL 36830

This research examines freewheel and chainwheel combinations for a ten-speed bicycle in order to establish the proper gearing sequence, the amount of work done per revolution of the crank, and the efficiency of the bicycle.

The proper gearing sequence is determined by two different experiments and one theoretical calculation. Both experiments and the theoretical calculation give the same results.

The work done on the bicycle per revolution of the crank was determined for several different gears and was found to be independent of the gear. Shifting gears increases the mechanical advantage but it does not decrease the amount of work per revolution of the crank.

The efficiency of the bicycle is .96.

#"DEVELOPING A NEW METHOD OF CONSTRUCTING INTEGRATED RADIO CIRCUITS"

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PURPOSE - To design and devise a method of constructing "One Piece Integrated Radio Circuits" through the study of Electromagnetic Radiation, Electricity, Electrical Circuits, and Electrical Components. Secondly, the purpose was to design and construct simple to highly complex One Piece Integrated Radio Receiving and Broadcasting Circuits. After the elementary techniques were perfected, experimentation on the design and construction of two-way radio communication transceivers began.

PROCEDURE - First, data was gathered on the construction of electrical components, hypotheses were formed on their composition and structure, and the components were formed. After which, the principles of electrical circuits and radio schematics were studied and then the components were connected by heat and chemical changes into "One Piece Integrated Radio Receiving and Broadcasting Circuits".

RESULTS - The experimentation of this project showed that integrated circuits could be formed by using Electrical Components containing the following material: Resistors - an Iron,Sulfur and Carbon mixture; Capacitors - a setup containing two Metal Conductors and a Dielectric (different plate/dielectric combinations were tested); and Detectors - different types of Lead/Ore compounds.

CONCLUSIONS - The experiments in this investigation revealed that a chemical mixture of iron and sulfur, when lightly heated,would form a solid conductive substance. The fact that this starts as a powder enables other substances to be added in given quantities to form other components, such as adding carbon to form a resistor. Therefore, by using this method to construct electrical components in a given sequence one can construct Integrated Circuits.

#Second Award - United States Army
Honorable Mention - National Aeronautics and Space Administration

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#A COMPARISON OF THE RELATIVE STRENGTH OF CEMENT AND FLY ASH USED IN CONCRETE

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The purpose of my project was to determine if fly ash, a waste material from coal fired electrical generating plants, could be successfully substituted for portland cement in making concrete.

The practical aspect of the project was to make cheaper concrete taking into consideration the strength of the fly ash and cement mixtures. I thought the substitution would work so I tested my idea. First, I built twelve 18" x 4" x 2" wood concrete forms to make my test bricks. Secondly, I mixed different ratios of fly ash, cement, sand or bottom ash, and water. The wet concrete was then poured into the forms and allowed to cure at room temperature for a two-week period. Finally, I gave the concrete specimens a span strength test to determine the relative strength.

My results of the tests showed a 75% fly ash-25% cement mix to be the least costly ($46 per cubic yard) and to be comparatively strong (97% as strong as cement concrete). The 75% fly ash cut the cost down; the 25% cement gave it wear durability.

In conclusion, pure fly ash is not the best because it is too flaky and wears down easily. Use more cement in the mix for better durability.

#First Award - Bureau of Reclamation/U.S. Department of the Interior
Third Award - American Society of Civil Engineers

*AN INTEGRATED DUST EXPLOSION CONTROL SYSTEM: RELIEF VENTING AND SECTIONAL SUPPRESSION BARRIERS

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47904

In continuation with my investigation of dust explosions in grain elevators, I developed two original safety sytems. The first was a suppression system that detected an oncoming primary explosion and activated two solenoid valves placed prior to the silo area. A suppressant material was released through these solenoids. It formed a barrier against the explosion and extinguished it before major damage could be done to the silos. The other safety system involved a two stage venting process located within the headhouse. The headhouse is the area in which grain is transported into and out of the silos. Cost/value was an important consideration in the design of the vents. One venting system involved covering an entire wall of the headhouse with a small width vent chamber. The other venting system incorporated a "mobile-roof" concept. When sufficient pressure existed, both vent doors opened. The primary advantage to using two venting systems such as I designed is that the rapid expansion of gases from the secondary dust explosion cannot be weakened sufficiently by one vent. Any vent is a passive means of prevention. Consequently, because the explosion is so rapid, it must be channeled down in stages to weaken it enough to be safe. I feel that I designed a combination of safety systems that will provide complete secondary dust explosion prevention for the entire grain handling facility.

*Second Award - Junior Engineering Technical Society
Third Award - General Motors ISEF

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*Ronald Lee Cline
1101 Alabama, Hobbs, NM 88240
Hobbs High School
300 N. Jefferson, Hobbs, NM 88240

ENHANCED OIL RECOVERY FOR A MORE INDEPENDENT AMERICA

Experts believe there are some 300 billion barrels of oil still held within the earth's formations in the United States. Primary production of oil wells leaves about two-thirds of the oil still locked within the formations deep within the earth. In order to obtain the remaining oil, it is necessary to inject a fluid to help force the oil into the area of a recovery well.

Secondary recovery consists of different types of reservoir flooding. In researching this flooding. I made slides containing a formation pattern. Into these slides, I injected various fluids to determine which fluid produced the best oil recovery.

I found the higher viscosity fluids displaced the crude oil best. Those slides in which I followed the primary flood of polymer or surfactant with a second flood of water or alcohol water base had a high recovery. The second flood had a tendency to "finger" through the first flood. This was due to viscosity differences.

The best recovery within the slides was a flood of surfactant which contained an additive of acrylate co-polymer. It had an excellent flow pattern from the injection wells to the recovery well. The amount of oil left in the formation was less than the other slides.

*First Award - U.S. Department of Energy

SOLAR WATER HEATER

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Hoxbar Route, Box 58, Ardmore, Oklahoma 73401

Solar energy can supply a useful amount of our energy needs now and in the future. The purpose of this project was to show one way solar energy can be used to benefit us. That one way is to heat water.

A small experimental solar water heater was constructed. It consists of three tanks with insulated reflectors enclosed in a glass fronted wooden cabinet. The reflectors, which are behind the tanks, concentrate the sun's rays on the tanks to heat the water inside.

The data obtained showed the solar water heater worked well. The highest temperature the water was ever heated to was 187 degrees Fahrenheit. At that time the air temperature was at 83 degrees Fahrenheit and the incoming cold water temperature was at 54 degrees Fahrenheit. The largest temperature increase over the cold water temperature was 133 degrees Fahrenheit. At that time the air temperature was at 83 degrees Fahrenheit.

This solar water heater is basically a preheater. Under normal use it will heat the water before it will go into a conventional water heater. The preheated water going into the conventional water heater will save energy because the conventional water heater will not have to heat the water much or at all.

A solar water heater of this type on a larger scale could be used as a preheater to heat the water for a home or a commercial building. This would save a considerable amount of energy.

RADIOACTIVE WASTE UTILIZATION STORAGE METHOD ENHANCING BENEFICIAL RADIOISOTOPE TRANSITION

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One of the major concerns for the advancement of nuclear energy is that of safety. Of particular concern is the disposal or storage of radioactive wastes. Man's future depends on his ability to find new ways and means of developing energy cleanly while utilizing his waste materials. Most attempts in the past have been to dispose of nuclear wastes rather than to store and utilize them. Man may discover new ways of using his wastes if he uses his ingenuity and desire for a better life to drive his dreams into reality. I have approached the nuclear waste dilemma from two standpoints. Both hold great possibilities for future developments. (1) Safety storage which is retrievable. (2) Utilization of nuclear wastes. As Robert Brown so clearly stated, "Ah, but a man's dream should exceed his grasp or what's a heaven for." The problem investigated was: Can a beneficial, safe, economical means for radioactive waste utilization be instituted considering liquid and solid wastes from fissioned and actinide products. Sub-problem: (1) Can a simple but safe storage mechanism for radioactive liquid be designed? Furthermore, can it be made functional to prevent the occurrence of leachetts? (2) Can radioactive materials be utilized beneficially for the following: a. Isotope production. b. Seed sterilization. c. Disease research. (3) Can eluding drums be designed to store liquid and solid wastes so they are retrievable for future generations? (4) Can a storage bunker system be designed for radioactive storage?

#CRICKET BOWLING MACHINE

Watson, Jay, The King's School, Peterborough;
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In cricket the batsman can expect a very wide range of balls varying in speed and pitch (point of bounce), and since he is entitled to hit the ball anywhere around him he needs to learn and perfect a wide variety of standard strokes. This machine enables him to do this (generally in a netted area and under the instruction of a coach) by bowling at any selected speed and on any line and length, repeatedly, tirelessly, and with far greater accuracy and consistency than any human bowler can achieve. Thus the batsman can repeatedly practise thoseparticular strokes that give him difficulty.

The design specification required a full range of speeds between 20 and 75mph, any pitch from "bouncer" to "full toss", a recognisable bowling action, ease of operation and transportation, safety, and above all, accuracy and consistency. To achieve this the machine consists of an arm driven by springs attached to a pulley, which accelerates the ball around a semi-circular guide. At the end of the guide, the ball is projected forwards at a tangent, and the arm arrested again by the springs. Speed variation is obtained by selecting one of three gears and then varying the tension in the springs; and pitch variation by adjusting the angle of the guide. After each delivery the arm is retracted and latched by a lever and another ball placed in the guide. To bowl again the operator plunges the lever which both tensions the springs to the set limit and trips the bowling arm.

The machine can just as easily be set to pitch baseballs.

#First Award - General Motors ISEF

THE CONSTRUCTION OF A LIQUID LASER FOR THE N.A.S.A. GET AWAY SPECIAL PROGRAM

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This project has been developed as an exercise in engineering. The experiment is the construction of a liquid laser to fit the constraints of the N.A.S.A. Get Away Special program of the Space Shuttle.

The main consideration involved in the N.A.S.A., G.A.S. program is the hands-off operation of the individual projects. Therefore, the laser is self-contained, including its own data gathering and storage devices. Other design considerations include: volume, weight, vibration, temperature, and power consumption.

Once in space the experiment will measure the temperature of the laser liquid, also known as the dye, the temperature of the atmosphere around the laser, and the wave length and the power output of the laser.

The research for this project was gathered in the years 1979-1982; the lab work and testing were performed in the 1982/83 school year.

HOW CAN A SIMPLE WORKING ROBOT BE CONSTRUCTED?

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The purpose of this project is to discover how a robot can be constructed. The robot needs to perform a certain function, and act without human control.

To discover the answer to the problem, a robot was designed and built. It is programmable by using 24 switches, and can perform several basic functions, including searching for light and finding its way around obstacles. Seven relays are used to guide the robot's behavior. For steering and drive power, two independent motors are used, allowing it to steer in the same manner as a bulldozer. Photoelectric cells let the system locate lights, and a bumper lets it sense obstacles.

When it was placed in a room with a light beam, the robot turned in a circle until it located the beam of light. The robot then went toward the light. If it encountered an obstacle, it backed up and turned away, then continued the search.

The robot works well, proving that this is one way a simple working robot can be constructed.

Several applications of the technology explored in the project present themselves. The most obvious use is in cybernetics research. The control systems are basically similar to those used in unmanned space probes. The vision system has such applications as controlling factory robots and aiding in targeting missiles.

HIGH-SPEED TURBOPROPS

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Some high-speed turboprops are the Adv. Turboprop and the General Aviation propeller. The G.A. prop is the propeller used in aircraft today. NASA tested these two, designated SR-3 (for Adv.) and SR-2 (G.A.), this is the basis of my experiment. Testing was done in a 1.75m windtunnel with diameters going from .22-.46m. The propellers were cut by myself and made of 2 polymers, Lexan (SR-2) and plexiglas (SR-3). Testing was done on a 3-speed, 60 watt household fan. The SR-3 was first and all necessary measurements were made. The airflow was determined with celephane, as shown in the photos. The rotary velocity was found by using a "clicker" system on 10-20 sec. intervals. The testing paralleled that of NASA except when the props. weren't rotating. The power was found by using force, radius and time; efficiency was graphed as a function of time. This SR-3 was more efficient than the SR-2. The SR-3 I constructed was compared with NASA's SR-3. The eff. graph of NASA's is hyperbolic while mine is a paraboloid, but both have the same basic characteristics. The airflow of the 2 were compared and NASA's had an interaction while mine didn't. In conclusion, the SR-3 outdid the SR-2 in all aspects. The SR-2 showed excitations in the velocity by violently shaking the fan set-up. The Adv. Turboprop is already being considered as the next step in jet aviation and be expected to see it within 10 years.

#FINITE ELEMENT METHOD

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130 Palisade Cir., Manitou Sp., Co 80829

The purpose of this project is to study the procedures, applications, and benefits of the finite element method (FEM). The class of problems solvable by the method is identified, and the basic steps in obtaining a solution are outlined. A computer program was prepared to illustrate the application of the method to stress-deformation problems.

The FEM is a numerical method for solving the class of problems termed field problems. Various books and articles were reviewed to achieve an understanding of the basic steps used in obtaining FEM solutions. Once these basic steps were known, a more specific study was made concentrating on solving stress-deformation problems. A computer program was constructed to obtain data to compare results obtained by the FEM with theoritical solutions for the same problem.

When the results obtained from the FEM were compared with exact solutions for the same problem, the FEM results were qualitatively correct, but, due to computer word and memory limitations, showed quantitative error. However, as element size and/or configuration was changed, the results from the FEM changed both qualitatively and quantitatively. This secsitivity to element size and arrangement is one of the difficulties in using the FEM. Experience and iteration are necessory to achieve accurate results.

In conclusion, the FEM provides a means to solve certain types of complex engineering problems not solvable by other practical means. As larger, more powerful computers have become more available and affordable, the use of the FEM has become less expensive and more wide spread.

#Alternate Award - Society of Exploration Geophysicists

PARABOLIC SOLAR COLLECTOR

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To build and test a model of a parabolic solar collector. Conclusion: whether a large scale collector of this type would be feasible as an alternate energy source. Project has plywood box frame with ribs cut to shape of parabola with mirrored surface attached to ribs. Copper tubing was installed at the focal point, through which water would circulate. The experiment was set up in a clear, sunny area, and was aligned with the sun by means of shadows. When perpendicular to the sun, the shadow of the collecting tubing fell in the direct center of the mirror. The 9.5 liter of water was circulated for a period of approximately 30 seconds after which the water was allowed to sit for a period of 2 to 5 minutes. After this, the water temperature in the tank was recorded, and repeated. Experiments lasted 2-3 hours. Highest reservoir water temperature recorded was 65° celcius. Conclusions: that parabolic solar collectors are an effective way of heating water, it was also concluded that it is presently feasible for use by homeowners as the unit will not function properly without constant proper allignment.

SOLAR COLLECTOR ORIENTATION

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What is the most effective position of a solar collector by degrees latitude and variation in direction? In order to determine the most effective position it is necessary to experiment with "mini" solar collectors. The solar collectors should absorb the maximum amount of heat available.

Six "mini" collectors were constructed for use in this experimant. They were built in such a fashion that they were moveable and yet could absorb the sun's rays. The collectors were constructed out of a wooden frame containing the absorber plate, copper painted flat-black, and insulation to protect it from losing the harvested energy. Each collector was attached to a controller by means of a sensor in order to measure the amount of heat absorbed by the copper.

In the first experiment, the collectors were positioned in various directions. Collectors one through six were in positions of 30° west of south, 20° west of south, 10° west of south, south, 10° east of south, and 20° east of south, respectively. The solar collectors were set up and attached to the controller; thus ready for testing.

During the testing the collectors were placed in sunlight with the temperatures recorded every 5 minutes for a period of an hour. The position that appeared most favorable for reception of the maximum amount of heat was 20° west of south.

In the second part the original six collectors were again used but were mounted by degrees latitude. Collectors one through six were placed in latitudes of 55°,50°,45°,40°,35° and 30°, respectively. The Collectors were tested as in part one. The result was that the optimum angle of a solar collector was 50° latitude.

#ADVANTAGES OF PNEUMATICS IN ROBOTICS

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The intent of this project is to demonstrate the advantages of pneumatics in robotics. To exhibit these advantages, I have designed and constructed a robot that runs solely off of air power.

The frame of the robot consists of two wooden bases supported by 2.54 cm diameter aluminum tubing. The onboard air compressor supplies the air which is stored in the air reserve tank. The air in the reserve tank is routed to a high pressure gauge, next through an air shut-off valve, and then through a regulator. The regulator governs the pressure input from a high of 5.71 $\mathrm{Kg/cm^2}$ down to a low pressure output of 2.14 $\mathrm{Kg/cm^2}$. The air then travels through the low pressure output gauge, and then into the air valves.

The air valves are operated by the servos, which are controlled by a 4 channel radio. From there the air travels to the syringes which in turn move the arm of the robot.

Through the utilization of pneumatics in robotics, the following conclusions can be drawn. First, the design and construction of the robot is simplified; therefore, the initial cost of the project is lowered. Second, the total weight of the robot is lessened; therefore, the robot is more manageable. Thirdly, the pneumatically powered robot runs more smoothly than an electronic driven robot.

The robot, if mobilized, could be used in space expeditions, as well as in handling radio active or toxic materials.

#First Award - National Fluid Power Association
Fourth Award - General Motors ISEF

#COMPARATIVE ANALYSIS OF FLUID LAMINAR FLOW AROUND SELECT WING SECTIONS

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Delta, CO 81416

Purpose: I started the project to prove to myself that the conventional airfoil shape now in use was the most effective. If I found it not to be, what shape is and why is it not used?

Procedure: Using an open end wind tunnel, I analyzed the airflow around three wing sections: the Karman-Trefftz airfoil, a flat plate, and a circular cylinder. For each wing section, excluding the cylinder, I tested at angles of attack of 18 and 30 degrees respectively. In the testing of the cylinder, I used both a zero and a positive rotation. I found the cylinder by far the most effective wing section when in rotation, but also determined it impractical due to added fuel costs, etc., when applied to aircraft. I then decided to combine the two and determine the effectiveness of a small rotating cylinder at the leading edge of an airfoil. I tested this modified wing at 18 and 30 degree angles of attack also.

Data: I determined that the mod-wing had a substantially higher coefficient of lift than any of the afore mentioned wing sections. When the cylinder was in a positive rotation, vortex shedding was reduced substantially.

Conclusion: By reducing the surface friction at the leading edge of an airfoil, with the use of a rotating cylinder, vertex shedding (drag) is reduced. Therefore, lift is increased.

Applications: In practical applications, the fuel cost of the engines required to rotate the small cylinders at the leading edge of an airfoil is minimal, and the increased lift is desirable, in short take-off and landing (STOL) aircraft.

#First Award - General Motors Corporation
Second Award - United States Air Force
Fourth Award - General Motors ISEF

Design and Development of a Thermoelectric Generator

by Mike Hickman
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My project deals with the direct energy conversion of heat to electricity through the application of the Seebeck effect. This effect states that when two different metals are joined to form a loop and the two junctions are kept at different temperatures, an electrical current is produced. I used this phenomena by building and testing several different thermopiles (loops of metal called thermocouples and connected in series) to find the best design.

I have tested two different designs so far. Each design has been modified a number of times. The designs are cylindrical in shape so that allithe "hot" junctions are inside the container and all the "cold" junctions are outside the container. This is accomplished by penetrating the wall of the container with the metals.

The first design consists of two plastic containers, one within the other, with spray foam insulation in-between the containers. The second design consists of a ceramic container with a black underglaze inside. Each of the designs have 5mm x 19mm slits cut into them and one ceramic design modification has 6mm holes instead of slits.

The best design at this stage in testing is the first one using plastic containers. It was modified four times so that the "hot" junctions were completely surrounded with aluminum. This unit produced six millivolts.

I plan to go on and keep working with the design and development of this until I can find a unit suitable for use in everyday life.

MATHEMATICS AND COMPUTERS

#ON THE SEARCH FOR AN ODD PERFECT NUMBER III

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A perfect number is by definition any integer that is the sum of its proper divisors. Although many even perfect numbers have been found, the existence of an odd perfect number has eluded mankind since it was created in theory over 2500 years ago by the ancient Greeks. It is probably the second most famous unsolved problem in mathematics.

An original technique is used to explore the nature of these numbers. New results concerning the number of factors, the size of the factors and the size of the number itself are presented. The mathematics is intuitive and does not involve advanced concepts. Topics currently being investigated by the author are also discussed.

#First Award - Mathematical Association of American
First Award - U.S. Navy/Naval War College
Third Award - General Motors ISEF

AN ALGORITHM TO TEST MERSENNE NUMBERS

Gider, Savas
Our Lady of Lourdes H.S., Poughkeepsie, NY 12601
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Named for French mathematician Marin Mersenne, the Mersenne prime number series consists of numbers one less than a power of two; however, numbers one less than a power of two are not invariably prime. Therefore, there exists both Mersenne primes and Mersenne composites. The objective of this project is to develop an algorithm or computer program to test the primality of Mersenne numbers.

The coding of the algorithm was in the APL language, and the program was tested on an IBM 4341 central processing unit. Pierre de Fermat's "little theorem" and modular mathematics were the principles utilized in developing the algorithm, and a list of the known Mersenne primes was the control of the experiment. The development of the algorithm MARINC based on Fermat's theorem was preceded by research and development of two other algorithms, MARINA and MARINB, based on factorization and trial division.

In summary, an algorithm to differentiate Mersenne primes from Mersenne composites has applications in the field of cryptography as the basis of a code and in public access systems which would use the Mersenne prime number series as the "key" to the system. Both these applications would rely on the difficulty of testing a large number for primality.

#Text-to-Speech Voice Synthesis for the Spanish Language

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Speech synthesis consists of reconstructing or generating the sound patterns of the human voice with the aid of electronic devices. Synthesized speech can provide an effective and more personal interface between man and the computer. Even more, the information handling capabilities of a computer teamed with a voice synthesizer can provide the disabled, i. e. the blind or the speech impaired person, with a new tool to overcome his limitations. For this, there should be a mean to translate written material, as the computer handles information, into speech patterns. There is no such system commercialy available to the Spanish speaking world, so the purpose of this work is to design and build a development system for computer generated speech in the Spanish language.

The work was divided in two main sections: hardware construction and software design. The hardware consists of a flexible interface board, to be used with any computer, and the speech synthesizer. The interface uses four 74LS85 digital comparators for address decoding, a 74LS21 and 74LS04 for I/O control and a 74LS244 for data buffering. The synthesizer is the Votrax's SC-01 LSI chip with an LM386 audio amplifier.

The software up to now was developed in a Sinclair's ZX-81 with 64K RAM and 8K BASIC. It's a completely menu driven package that features a text editor, full phoneme table editor and a translation algorithm with machine language subroutines to control the data output of the synthesizer. A version for the Apple)(written in Applesoft, was also completed except for the machine subroutine.

#Second Award - IEEE Computer Society
Second Award - United States Navy

COUNTING SQUARES, REGIONS, AND TRIANGLES

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This project began by counting the squares formed by the lines on a chessboard. At first glance it may seem that the board contains only 64 squares, yet the different sized squares, such as 2X2's and 3X3's, also need to be considered. I discovered by counting, that a pattern was formed. From that information I developed a formula to solve any NXN square. The formula is $\sum_{i=1}^{n} i^2 = \frac{n(n+1)(2n+1)}{6}$. I then proved this formula by mathematical induction.

After discovering and proving this pattern, I went on to examine regions and triangles. I discovered for regions that the maximum number of regions for n folds in that region would be $\frac{n(n+1)}{2}+1$ and the formula formula for the total number of triangles with any n number of folds would be n:the number of folds in the triangles + the number of triangles of (n-1) + 1. Both of these cases could not be proved as in the case of the squares, because the figures were not similar and that the regions and triangles were not exactly the same.

Therefore, the squares in a chessboard is one such case in mathematics that can be used in developing patterns to proven formula. All three cases can be used in showing mathematical reasoning and in experiments in discorering number patterns.

#ON MATHEMATICS AND APPLICATIONS OF SPIRO-GRAPHS

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This study was motivated by the curves drawn by a spiro-graph. The curves drawn can be either a hypocycloid, an epicycloid or a cycloid. This study discusses the equations of these curves.

By letting one constant in the equations of a hypocycloid or an epicycloid tend to infinity, the equations become that of a cycloid. Similarly, by assigning different values for the constants in the equations of a hypocycloid or an epicycloid, we get an ellipse, a circle, a line segment, a straight-line, a star-shaped curve, a conchoid or a rose curve.

As an application of the discussion on those equations, we find that the spiro-graph drawing kit is able to help us accomplish three famous classic geometric constructions, namely,

1). trisecting an arbitrary angle (the extension of this problem to multiple-secting an arbitrary angle can be done by the same construction method)
2). duplicating a cube
3). squaring a circle

These geometric constructions were proved impossible using only straight-edged ruler and compass.

All the curves and geometric constructions were demonstrated by micro-computer-graphics.

#First Award - General Motors ISEF
Second Award - Mathematical Association of America

'PLANE FUN' - GEOMETRIC REVIEW

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'PLANE FUN' is a computer program written in BASIC for the Commodore PET. Many hours were spent on this unique project which deals with plane geometry. 'PLANE FUN' can readily be used as an educational tool in the area of geometry.

The program has two sections. The first section will quiz the user on the definitions of a circle, triangle, square, rectangle, rhombus, and trapezoid. It will allow the user to enter answers, and the computer will respond by identifying the input as correct or incorrect. There are six such questions.

The second section will allow the user to find the area of a triangle, square, rectangle, rhombus, and trapezoid. The figure with the formula for its area and randomly generated numbers will appear on the screen. This cycle will be repeated four times for the five geometric regions.

Throughout the program, the computer will keep track of the correct answers and display the results at the end of the program.

#ARTIFICIAL INTELLIGENCE: A NOVEL APPROACH TO AN ALGORITHM FOR A COMPUTER BASED GENERAL PURPOSE THEOREM PROVER.

Woody, William E., Clovis West High School, Fresno, CA 93710;
8038 N. Mariposa, Fresno, CA 93710.

A major field in Artificial Intelligence is theorem proving. For this project, I developed a theorem prover capable of proving any goal statement using any system of axioms. By using the Unification Algorithm, the goal statement is matched with the system of axioms, and a solution is found and returned in a two column form much in the same way as a geometry student does, when he first learns how to solve proofs.

#First Award - Association for Computing Machinery
Second Award - General Motors ISEF

#A NEW APPROXIMATION FOR THE DISTRIBUTION OF PRIME NUMBERS

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This paper presents a revision of the Logarithmic Integral approximation [Li(x)] of the function $\pi(x)$, where $\pi(x)$ is the number of primes less than or equal to x. The function, named Mi(x), was obtained by allowing the lower limit of integration of the logarithmic integral to vary directly as the upper one. Causing the lower limit to vary as the square root of the upper limit provides an approximation of $\pi(x)$ of accuracy equal to or better than Li(x). It was also found that various averages of the two functions privided even more accurate estimations of $\pi(x)$.

#First Award - General Motors ISEF

MATHEMATICAL PALINDROMES - MATHEMATICAL PHENOMENON OR MATHETICAL COINCIDENCE

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Mathematical palindromes are numbers which read the same when sequentially reversed, such as 121, 1441, 12321, etc.

Initially a list was compiled of all palindromes from 1 to 1000. Once these were identified, specific mathematical calculations were performed in each palindrome in an effort to identify any significant pattern or sequence. These calculations included square, square root, log, Palindrome (P) x 11, P ÷ 11, P ÷ 10, P - 10, and sequences of the sums of palindromes.

In addition to the "by hand" method, a computer program was written in the Basic Language to perform all calculations. Observations were made and general conclusions drawn.

#ELECTRONIC METHODS FOR SYNTHESIZING VOICE TO IMPROVE COMPUTER USAGE

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It is now possible to electronically synthesize the human voice so that speech can be an integral part of personal computers. This revolutionary feature provides significant advantages to users by making it faster and easier to operate, communicate and interact with the computer. It also provides flexibility in utilizing the computer by the non-technical user, individuals who can't read and such handicapped people as the blind and mute.

In this project, three state of the art methods of voice synthesis have been researched - Linear Predictive Coding, Continuously Variable Slope Delta-modulation and Threshold Propagation. The first and second methods use hardware, that is electronic components and equipment, to produce speech. The third method uses software, mathematical algorithms, to create sounds similar to the human voice. The researcher has designed and constructed actual models for each of the three methods. In two of these models original work has been incorporated to provide some advantages not previously obtained.

The theory, advantages, disadvantages and innovations as designed by the researcher are discussed for each method. As a result of analyzing the strengths and weaknesses of these synthesis techniques, it was determined that design trade-offs and technical modifications were possible for improved performance.

In summary, the addition of voice generation and processing to a computer can provide a viable and productive means to expand the potential applications, audience and benefits of an already powerful machine.

#Fourth Award - General Motors ISEF

#DRAW: A COMPUTER DISPLAY PROGRAM FOR THE OSBORNE 1

Baughman, Steven, Upper Dublin H.S., Fort Washington, PA 19034
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The purpose of this research project is to write a BASIC computer program that allows the user to create, save, print, edit, and display pictures or designs on the screen of an Osborne 1 microcomputer using ASCII and graphics characters.

Procedure

1. Analyze problem and set goals to be accomplished by the program.
2. Flowchart basic program operation and outline function sequences.
3. Research commands unique to the hardware being used.
4. Write BASIC program using the flowchart from step two.
5. Debug the program--check to see if the goals from step one are met.
6. Document the program.
7. Draw conclusions.
8. Analyze possible expansions of the program.
9. Complete any expansions and update the conclusions.

It is possible to write a computer program in BASIC that allows the user to create, save, print, edit, and display pictures or designs on the screen of an Osborne 1, using ASCII and graphics characters. Further experimentation has shown that the program can be expanded to allow the user to incorporate animation into these pictures, and to drastically reduce the amount of disk space used when saving them.

#Second Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society

#SCIENTIFIC APPLICATION OF A COMPUTER: THE MEASUREMENT OF g

Bencze, William J., St. Francis High School, Mountain View, CA 94035
19287 Brookview Drive, Saratoga, CA 95070

The overall goal of this project is to design and build a working computer system which can be easily modified to suit future needs.

The current objective is to develop both hardware and software which demonstrates a practical application of a computer to the solution of a scientific or engineering problem. The experiment chosen was to measure the acceleration of gravity(g). The computer was used to control the experiment, acquire data, perform the necessary computations, and display the results.

An existing 8-bit microprocessor system (a previous science fair project) was expanded to include input, output, and timing circuitry. Machine language software was written to control the experiment and compute the results. All computations were performed using floating point arithemtic with eight significant figures. A 6.4 cm diameter, 137.0 cm long instrumented vacuum chamber was designed and built to acquire data over a range of air densities. Four infrared photo transitors, located 30.0 cm apart along the length of the vacuum chamber, were used to sense the time of flight of the test object. The time of flight was then used to compute the acceleration of gravity assuming no air resistence. In addition, the influence of the residual magnetism of the support coil was investigated.

The hardware and software were successfully completed. The acceleration of gravity was measured in a vacuum with a result of 944.5cm/sec^2. This is within 4% of the actual value. It was found that the air resistence and residual magnetism of the support coil affected the test object's flight significantly. Extrapolation of the data for a total vacuum to zero magnetic field yielded a value of g=980 cm/sec^2.

#Third Award - General Motors ISEF
Honorable Mention - United States Air Force
Alternate Award - Society of Exploration Geophysicists

#PERFECT NUMBERS: PHASE II

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The purpose of this project is to determine the properties of even perfect numbers. Before this can be accomplished, one must first know that a positive integer a is called perfect in case $\sigma'(a) = a$, which denotes the sum of the proper divisors of a is equivalent to a.

The procedure used to determine the properties of even perfect numbers includes (1) studying consecutive even perfect numbers for patterns and (2) proving what appears to be true for all even perfect numbers.

The results include five theorems: (1) if 2^p-1 is prime, then $a = 2^{p-1}(2^p-1)$ is perfect and every even perfect number is of this form; (2) even perfect numbers are equivalent to the sum of the first 2^p-1 consecutive positive integers; (3) even perfect numbers greater than 6 have a digital root of 1; (4) even perfect numbers greater than 6 are equivalent to the sum of the first consecutive positive odd cubes; and (5) all even perfect numbers have either 6 or 8 as the ones digit.

#First Award - University of New Mexico Presidential Scholarship
Fourth Award - General Motors ISEF

#PREDICTING THE POSITION OF A SMALL BODY IN ORBIT

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The objective of this project was to write a computer program to compute the local azimuth and elevation of stars, planets and earth orbiting spacecraft at some input specified location and observation time.

To solve a problem of this size the program was broken down into smaller components. The first step was to establish a common time reference. After this was done the establishment of a common direction of reference was made. The next step was to find the stars in azimuth and elevation coordinates when they were given in right ascension and declination coordinates. The problem ends up being a coordinate system transformation problem. Keeping Kepler's laws in mind and the basics of physics, the transformation was completed. The task of predicting where the planets will be is a much more difficult problem. There are six coordinate system transformations. It is necessary that close attention is paid to which coordinate system a vector is in and how it can be transformed into another.

This project has given me a much better understanding of the complexities of the "real world" problems. Tackling this project as a whole world would have ended up in a failure but breaking it down into smaller components allowed the problems to become understandable as well as solvable.

#First Award - United States Air Force
Third Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

MATHEMATICAL TOOLS FOR STUDY OF A PENDULUM

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Mathematical Tools for Study of a Pendulum

Mathematical tools, in particular computer programs and statistical analysis, were developed to study a pendulum. These tools permit time resolution of the order of 10 microseconds.

To achieve these resolutions it was necessary to write programs using assembler language. These programs communicate with the pendulum through a magnetic switch wired in parallel with a game paddle button. This switch sets a memory location when triggered by a magnet on the pendulum weight. The program inspects this location and times the period between settings.

Statistical tools are used to interpret the data. There are some pitfalls in using these tools. For example simple averaging is a powerful tool, but it may hide non-random variations in the data. Special averaging techniques are under study.

High resolution timing has many applications. These include: vibration analysis, disk drive operations, automatic machinery, digital voltmeters and a variety of electronic applications, automatic radio stations, and many others.

The next step in studying the pendulum in depth will be to construct a more rigid frame. This should minimize many of the observed spurious vibrations. I expect to use additional statistical tests. Another mechanical improvement would be the use of a light-activated switch to replace the reed switch.

#CUBIK MATH: A COMPUTER TUTORIAL IN GROUP THEORY

Lin, Michael T., La Jolla H.S., La Jolla, CA 92037
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The goal of the project was to design a computer program that teaches group theory using Rubik's cube as a model. The idea was to create an enjoyable learning experience: users have fun playing with the cube, and simultaneously pick up the mathematics it illustrates.

The program's format is to lead the user through a solution of the cube, commenting along the way on the underlying mathematics. I did the following to develop the program:

(1) listed how to solve the cube from ANY of its 4.3×10^{19} starting positions. I reduced this to 232 situations by taking each piece 1 by 1.

(2) wrote the cube-solving program using top-down, block-structured techniques. The data structure conforms to the conceptualization of the cube as a set of smaller, moving pieces. The algorithm was implemented in Pascal because Pascal lends itself naturally to modularized programming and offers a wide variety of data types.

(3) chose where and what to put in the mathematical commentaries. Choices were determined by (a) which solution processes led naturally into mathematical discussions, and (b) relevance to the cube's solution. These topics were chosen for discussion: groups, subgroups, cosets, permutation structure, and conjugates.

I have written a computer program that: (1) teaches group theory in a friendly way using the cube as an aid, (2) can be used to bring group theory down into high schools. I have created a unique piece of educational software exploiting the cube's possibilities for fun learning.

#Fourth Award - General Motors ISEF
Meritorius Award - United States Army

#THE TRUE PERSONAL COMPUTER (HAL II)

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Lake Park, Florida 33410

The purpose of this project was to design, build, and implement a mirocomputer system. The system was to have a cost of no more than 40% of the retail price of a comparable system. It should also be expandable to any computer function.

The design for the system, which is named HAL II, is built around the IEEE-696 standard, also known as the S-100 bus. The system controller is the Zilog Z80A microprocessor which runs at 4 Mega-Hertz. HAL II's memory capacity is 64 Kilobytes of Random Access Memory, 8 Kilobytes of Read Only Memory, and 22 Megabytes of Random Access Memory in disk drives. It also has three parallel input ports, three parallel output ports, and two serial input/output ports. In addition to these standard computer functions, HAL II contains a music synthesizer and a voice synthesizer/recognizer.

The total cost of HAL II came to approximately $1000. This is only 17.3% of the cost of the closest comparable system, the Cromemco System One.

#Third Award - General Motors ISEF

#ALGORITHMIC ANALYSIS OF DIVISIBILITY BETWEEN INTEGERS

Wang, Mark Y. D., Norman High School, Norman, Oklahoma 73069;
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The well known division algorithm has been the standard method for testing divisibility; from it, a number can be broken down into its prime power decomposition. Combinations of these prime factors are the possible divisors. There are "tricks," however, for the divisors 2, 3, and 5 that aid in determining divisibility. Besides these few cases, however, divisibility, particularly between large integers, remains a tedious process. My project addresses that problem. Using number theoretic techniques, I was able to get an understanding of these "tricks" which led to generalizations and insight as to the formation of new algorithms. My research presents divisibility tests for divisors of the form 2^n, 5^n, divisors of 10^n-1, 10^n+1, and divisors whose units digits are 1, 3, 7, and 9 (divisors which are relatively prime with 10). Two of my results that involve "unit multipliers" are the following:

Given that $a = (10)m \pm 1$ and $b = (10)k + n$. a divides b if and only if a divides $k \mp mn$.

Given that $a = (10)m \pm 3$ and $b = (10)k + n$. a divides b if and only if a divides $k \pm (3m \pm 1)n$.

One important realization was that the testing for divisibility is not equivalent to factoring a number in order to determine its divisors, a result of the division algorithm. This was a major misconception, and its elimination led swiftly and directly to new channels of progress.

#Third Award - General Motors ISEF

THREE DIMENSIONAL CREATION AND MANIPULATION ON THE APPLE 2+ MICROCOMPUTER

Bitts, Daniel A., Terre Haute North Vigo H.S., Terre Haute, IN 47804
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The purpose of my project is twofold: First, the creation and implementation of four system commands for three dimensional point and line segment plotting and manipulation that could be used by any Pascal programmer on virtually any Pascal implementation.

Second, the creation of an image editor which utilizes the four system commands that I have added to my Pascal implementation, with the capability of simple three dimensional image representation and manipulation on the graphical output device.

The routines are written in Apple Pascal, and I have converted some of the routines over to Indiana State University's CDC Cyber Computer to demonstrate the advantages of the use of a high level language for my project.

DEVELOPING SOFTWARE FOR DISK ANALYSIS AND RESTORATION

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On any computer system that uses floppy disks as a storage media, dust, power flickers, timing problems, and poor connections can cause a disk to become "bombed" or unusable. Though many accept this as an unfortunate but irreversible occurrence, I was not willing to sacrifice days of work because of a random error. Therefore I was determined to write a program which allowed me to recover my lost files. Research into the problem involved reading manuals, talking to other computer owners, and raw examination of disks using a clumsy BASIC command. I wrote a short program in December 1981 for my TRS-80 Color Computer which allowed a user to more easily examine a disk. Then I concluded that the lost programs were actually on the disk, but in a fashion that made them invisible to BASIC. I added a section to the program which allowed the restoration of these lost files. My program accomplishes this feat by loading one sector into memory, altering it, and then placing it back on the disk. This program, called DISKLOOK, was developed and improved over the course of the next year. From my research with the program I discovered exactly how DISK EXTENDED BASIC stored files on disks and how they could be protected and recovered. The program has saved countless hours of composing and typing for several owners of Color Computers by restoring their lost files. At present DISKLOOK is being advertised in the Rainbow Color Computer magazine.

#Third Award - General Motors ISEF
Honorable Mention - Upsilon Pi Epsilon

WHEN DO DIFFERENCES BECOME A CONSTANT?

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This project has its origin in a mathematics puzzle book. It applies to any four-digit number in which all digits are not the same. When arranged in descending order and ascending order, and the absolute difference of these two numbers is found, and this process is repeated with the absolute difference, eventually, a fixed number will spring out. For this surprising result, a general proof was developed for two-, three-, and four-digit numbers. By applying algebra, using permutations, and trying various techniques in solving simultaneous equations*, the proof shows that no fixed number exists for two-digit numbers. The fixed numbers for three-digit numbers and four-digit numbers are 495 and 6174 respectively. Applying the idea that all numbers progress back to the fixed number (except the two-digit numbers and numbers whose digits are all the same), some possible applications were developed pertaining to the handling of requests of books within the library system and the search for information in a computer system.

*Recently, I found some more suitable methods which will eliminate unnecessary combinations. This may be helpful in the proof of five-digit numbers or more (it may make the proof less tedious).

#BETA NUMBERS: A NEW SEQUENCE OF NUMBERS USED IN YIELDING THE SUMS OF POWERS OF THE FIRST "N" INTEGERS

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Bernoulli numbers and polynomials have been recognized for the important role they play in the theory of infinite series and in number theory. Initially, the objective of this project was to analyze Bernoulli numbers and polynomials and possibly develop new definitions for generating them. Upon analysis, however, a number sequence was uncovered which closely resembled Bernoulli numbers. The new objective was to try to develop a generating formula for these numbers and, in addition, try to find useful applications for them. The first few Beta (β) numbers have been defined as $\beta_0=1$, $\beta_1=1/2$, $\beta_2=1/6$, $\beta_3=0$...., while Bernoulli numbers are known as $B_0=1$, $B_1=-1/2$, $B_2=1/6$, $B_3=0$.... Though the differences seem small, the generating formulas of the Beta numbers and the properties of the Beta polynomials prove to be totally different from those for Bernoulli numbers and polynomials.

Briefly, the following were developed: a recursion formula for generating Beta numbers; a summation formula incorporating Beta numbers for yielding the sums of powers of the first "n" integers; Beta polynomials which exhibit properties in differential and integral calculus, and are also linked to a specific case of the binomial theorem. Further research is being done to discover a non-recursive means for generating Beta numbers.

#First Award - United States Army
Second Award - General Motors ISEF
Second Award - United States Air Force
Third Award - Mathematical Association of America

#THREE-DIMENSIONAL AND COLOR COMPUTER GRAPHICS

Fraley, Christopher L., Wilson H.S., W. Lawn, PA 19609
1753 York Road, Reading, PA 19610

The purpose of this project was to produce and animate three-dimensional and color graphic images using an Apple II plus computer. To accomplish this, an integer compiler and a floating-point compiler were written. Both programs compile a BASIC-like language into 6502 assembly language.

"Multicolor" was the name given to a method designed which allows one to produce over a million textures and hues for creating pictures. This technique uses the six standard colors available on the Apple and combines them into patterns similar to the way magazine pictures are made.

Three-dimensional vector shapes were displayed by a program written in BASIC. In addition, using the floating-point compiler, a program was developed that allows movies to be created frame by frame and then replayed.

Paint Brush10.1 is a program which integrates all of the above routines. This program allows the user to create movies, to display and animate three-dimensional shapes, and to create multicolor pictures.

#Fourth Award - General Motors ISEF
Honorable Mention - Upsilon Pi Epsilon

#6502 ASSEMBLY LANGUAGE MATHEMATICS

Gledhill, James B., Dixie High School, St. George, Utah 84770;
447 West 400 North, St. George, Utah 84770.

While studying Assembly Language I found that there was a need for mathematical subroutines. In Assembly Language the +, -, *, and / signs do not exist like they do in Basic Language. Therefore the programmer must make his own subroutine for these mathematical functions.

I found that Addition, Subtraction, Halving (X/2 or ½) and Doubling (X*2) were all very easy using the ADC, SBC, ROR, and ROL opcodes. Multiplication and Division do not have opcodes that can accomplish their functions, so you must use other opcodes to make them.

Multiplication can be accomplished by adding over and over, (7+7..+7=63) or by using addition and doubling (7*2=14*2=28*2=56+7=63). The plain addition subroutine is the easiest to make, but the combination of addition and doubling is faster with large numbers.

Division can be accomplished by subtraction (63-7=56...14-7=7-7=0) or by using both subtraction and halving. Integer(63/2=31/2=15/2=7-7=0)

1. Since the combination of opcodes is faster I followed this course.

2. I found that working with real numbers was very hard and tedious so therefore I worked only with Integers.

3. In the multiplication subroutine I halved (½) the multiplier. If the carry was clear then I would add, then double, using the combination of the two. Otherwise I would only add.

Example If you ROR '1001' it would put the '1' that was dropped into the carry, making '1001'='0100' carry='1'

4. Division was accomplished much the same way.

My study was very successful and I now have the Mathematical subroutines for '6502 Assembly Language Mathematics'.

#Honorable Mention - Association for Computing Machinery

THAT'S THE WAY THE BALL BOUNCES

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A rectangular table has four pockets, one in each corner. A ball is shot from the upper left corner at a 45° angle to the sides of the table. What path will the ball follow? Specifically, under what conditions will the ball eventually go into a pocket?

Based on experimental data obtained from hand drawings and computer simulations, conjectures concerning the path of the ball were made. Theoretical arguments were constructed to verify these conjectures and establish the following conclusions:

1. The ball eventually goes into a pocket if and only if the ratio of the length of the table to the width of the table (L/W) is a rational number.

2. If $L/W = P/Q$ where P and Q are relatively prime integers, the ball will go into the lower right pocket when P and Q are both odd, the upper right pocket when P is even and Q is odd, and the lower left pocket when P is odd and Q is even.

3. In the notation of 2 above the ball bounces $P + Q - 2$ times and travels a total distance of $LQ\sqrt{2}$ units.

4. The ball never bounces more than once from a point on the table's edge. Therefore, when L/W is irrational, the path of the ball, like the decimal expansion of L/W, is non-repeating.

#FORENSIC ANTHROPOLOGY VIA COMPUTER

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Forensic is the term used to deal with characteristics that are suitable for a court of law or public debate. Anthropology is the study of races,physical and mental characteristics, distribution, customs, social relationships, etc. pertaining to mankind. Therefore as one can see the two terms together describes the study in a legal manner of the characteristics of an individual usually after death.

The long process of determining this information can be accomplished much more efficiently with the use of a computer. Stemming through research, information obtained in Artistical Anatomy, Cephalometrics, Paleontology, Health and Forensic Medicine is combined into one computer program. The program can work with the length of one long bone, manipulating the cooresponding formulas to calibrate the stature of the individual from which the bone was taken. It also determines the length of six other critical bone measurements including the height of the skull. Given the distance from lateral to medial epicondyle of the humerus, the program can derive the optimum weight for that individual's skeletal structure. With access to the skull, stature, dental problems, facial abnormalities and shape of face to almost recognizable characteristics are extractable.

In the future, even identity will be gleaned with the information from only one bone and the use of a program such as this.

#Honorable Mention - Atari, Inc.

#S3L-A NEW COMPUTER LANGUAGE

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S3L (Structured Low-Level Language) is a computer language similar to PL/I and assembly language. Its source form is compiled or translated to symbolic assembly language by a compiler constructed by me. This assembly language is then assembled by a separate program and executed. The compiler, which is machine-dependent, is written in extended color basic for the TRS-80 Color Computer. The language's predefined variables have two forms, the 8-bit byte and the 16-bit word. There are instructions to make decisions, call subroutines, perform arithmetic, access a stack, and examine and change memory.

The language's similarity to assembly language makes it suitable for systems programming. Even the compiler could be written in S3L. Interpreters for other languages may also be written in this language. Its main applications will use it as an alternative to assembly language.

#First Award - Upsilon Pi Epsilon
Honorable Mention - Association for Computing Machinery

A COMPUTER AIDED STUDY OF TWO PARAMETER FAMILIES OF MAPS OF THE PLANE

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Recently, a field of mathematics, the study of iterated functions, has been the subject of a great deal of research. The relative newness of this field is largely due to its dependence on high speed digital computers in certain portions of the analysis.

Recall that an iterated function is a function that is repeatedly composed upon itself, or iterated. These functions are frequently used as mathematical models of dynamical systems. Among other areas, iterated functions are important in models of biological and hydrodynamical systems.

In this investigation, a function of two variables was chosen which originally modeled a predator-prey relationship, but was slightly modified for mathematical convenience. The function is $F(x,y) = (y+bx, ay(1-x))$, where a and b are independent parameters. The aim of this project was not to learn of the biological significance, but rather an analysis from a strictly mathematical standpoint.

Associated with $F(x,y)$ is a set of points called an unstable manifold of F. A rigorous definition of an unstable manifold is beyond the scope of this short paper, so it will just be noted that an unstable manifold is a set of points which plays an integral role in the behavior of the iterated function. The specific goal of this project was to determine the structure and interaction of two unstable manifolds associated with F. Through computer and mathematical analysis, the conclusion was made that the two manifolds approached each other asymptotically and displayed infinite detail, but remained distinct throughout.

#DETERMINING THE FEASIBILITY OF AUTOMATON COMPUTER DESIGN

Kenneth James Aanderud, Beech Senior High, Hendersonville, TN 37075
117 Woodridge Drive, Hendersonville, Tennessee 37075

Three computer programs were developed. The first program called "Robot Generator" applied the values entered by the user for a given environment and, employing pre-determined formulas, calculated the most efficient design for the robot to function in the given environment. These values were output to the printer and incorporated into the development of the CROPSY.64 operating system that would serve as the computer-simulated model of the actual robot.

Again, using the design parameters computed by the "Robot Generator" program, the robot was constructed. Elements such as speed and sensor range were adjusted according to the design parameters to make the robot as comparatively similar to the computer-simulated robot model of the CROPSY.64 operating system. The operating system for the robot, CROPSY.20, was then created.

The feasibility of the "Robot Generator" program to compute the most efficient robot (automaton) design for a given environment was determined by running the robot and the CROPSY.64 model in comparatively identical environments. The data generated by each was printed and compared for variances. No significant dissimilarity was found, thus indicating that this system preformed in a feasible manner.

#Fourth Award - General Motors ISEF

#ONE ELEMENT LOOPS

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Given any whole number, square each digit of that number and add the resulting squares together to form a new number. Square each digit of this new number and add the squares together to form yet another number. Continuing in this fashion the resulting series will eventually start to repeat in a "loop." Starting with any whole number, either the one element loop (0,0) or(1,1), or the eight element (4,16,37,58,89,145,42,20,4) is obtained. For example 23, $2^2+3^2=13$, $1^2+3^2=10$, $1^2+0^2=1$, $1^2=1$,... the loop (1,1) is obtained. Using 65, $6^2+5^2=61$, $6^2+1^2=37$, $3^2+7^2=58$, $5^2+8^2=89$, $8^2+9^2=145$, $1^2+4^2+5^2=42$, $4^2+2^2=20$, $2^2+0^2=4$, $4^2=16$, $1^2+6^2=37$,... the loop (4,16,37,58,89,145,42,20,4) is obtained.

Generalizing the concept of loops to a base b representation, and to where each digit is taken to a fixed power j, many interesting problems and results occur. One such result is that for a given base b, and a power $j=2$, the number of one element loops is equal to the number of divisors of b^2+1.

#Fourth Award - General Motors ISEF

#ADVANCING CUBE THEORY

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In the history of puzzles, the Rubik's cube is a classic. But it is more than a puzzle for it provides a tangible physical model for many pure mathematical and non-mathematical concepts. Rubik's cube, a 3 X 3 X 3 block, is a subset of all N X N X N cubes. This group in turn is a subset of all puzzles having N-dimensions - the universal set.

The purpose of this project is to explore the subsets of the universal set in order to develop general solutions to these groups.

The project began by incorporating the concept of conjugation developed in my original solution of the Rubik's cube (3 X 3 X 3) to solve Rubik's Revenge (4 X 4 X 4). A computer was then programmed to display and indicate the effect of rotation on the faces of cubes as large as a 38 X 38 X 38. Experimentation led to the development of an operator that made possible a general solution to the N X N X N.

By noting the characteristics of one, two, and three dimensional puzzles, it was possible to define ones of four or more dimensions. A lengthier computer program was written to rotate a four-dimensional "cube". Tests were then made to find if the operators in three dimensions had similar effects in four. The N X N X N operators applied with conjugations were found to be sufficient to solve 2 X 2 X 2 X 2, then the N X N X N X N. Movement on an N-dimensional cube with infinite edge length was defined and a theoretical basis for its solution was established. Further research is being done to prove the validity of that solution.

#Third Award - General Motors ISEF

INNOVATIONS IN MATHEMATICS

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The objectives of this math project are to explore different, perhaps simpler ways to: (1) square numbers, (2) cube numbers, (3) solve second-degree equations, (4) draw polar graphs, (5) show interesting relationships between integers, and (6) check squared numbers.

Through study and development, it has been determined that the operations referred to above are relatively easy to perform with large multi-digit numbers. The formulas for squaring and cubing a number are even more effective if one knows the squared or the cubed value of the preceding term.

When solving a second-degree equation, $ax^2+bx+c=0$, if $a+b+c=0$, then $x_1=1$ and $x_2=c/a$. If $a-b+c=0$, then $x_1=-1$ and $x_2=-c/a$.

In graphing a polar equation, $r=a\cos(b\theta+c)+d$, assign $y=r$ and graph on the Cartesian plane. Then interpret and transfer the change in y to the polar graph.

In objective (5), a numeral is squared, the digits of the resulting numeral are added and this result squared. If this pattern of operations is continued, the results will repeat themselves in one of three ways: (1) 1's will repeat, (2) 81's will repeat, or (3) 169 and 256 will alternate.

A method for checking the computed square of a number has been developed from the above relationship. Since the squares of integers would eventually have to follow in the same pattern as the integers themselves, this method could be used to spot incorrectly squared numerals.

FEASIBILITY OF CONVERGENT SERIES TO FIND ROOTS OF NUMBERS

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Having only a hand-held calculator that would perform the operations of +, -, ÷, X, √, 1/x together with a single memory, I was interested in expanding its capabilities so that I might find roots of numbers.

I first looked for an infinite goemetric series that converged to 1/3 by solving $(1/3) = a/(1-r)$, where $a = 1/(2^n)$, $n \in j$, $r = 1(2^k)$, $k \in j$. This resulted in $(1/3) = 1/2 - 1/4 + 1/8 - 1/16 + 1/32..$and $(1/3) = 1/4 + 1/16 + 1/64 + 1/256 + \ldots$ hence we would have that

$$\sqrt[3]{x} = \sqrt{\sqrt{x}} \cdot \sqrt{\sqrt{\sqrt{\sqrt{x}}}} \cdot \sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{x}}}}}} \cdot \sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{x}}}}}}}} \ldots\ldots$$

$$\sqrt[3]{x} = \sqrt{x} \div \sqrt{\sqrt{x}} \cdot \sqrt{\sqrt{\sqrt{x}}} \div \sqrt{\sqrt{\sqrt{\sqrt{x}}}} \cdot \sqrt{\sqrt{\sqrt{\sqrt{\sqrt{x}}}}} \div \ldots\ldots$$

I next addressed the general problem of finding a solution to the general equation

$$\frac{1}{x} = \frac{\frac{1}{2^n}}{1 - \frac{1}{2^k}}, \; x \in N,\ n \in j,\ k \in j.$$

I have demonstrated that it is possible to find any root of the form $x = (2^n \pm 1)$, $n \in j$, or of the form $x = (2^k)(2^n \pm 1)$, $k \in j$, $n \in j$. I next used a computer to search for acceptable values for which roots could be found. These I have compiled into a table.

#A POSITION SENSOR FOR ROBOTS

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I have implemented a system for locating the position of a robot in a room, i.e., with respect to its walls, using the range finding mechanism of a Polaroid camera. By ranging its distance from two intersecting walls at each end of the rail on which it is mounted the robot can determine its position and orientation with respect to the walls. It can also verify if the walls are flat, and determine the angle at which the walls meet. The robot uses the two stations on its rails for binocular vision.

The range finder works on the same principal as a sonar. Five times a second it transmits a set of pulses at four carefully selected ultrasonic frequencies between 50 and 60 KHz. The time delay between the transmitted pulses and the received echo is used to calculate the distance to the object.

The transmitting/receiving transducer from a Polaroid ranging kit is mounted on a stepper motor. The software in an INTEL 8085 computer commands the stepper motor to move in steps of 45 degrees. The distance to a wall is determined by interrupting the CPU when the sound pulses are transmitted. At this interrupt a timer starts counting. The timer continues counting until a second interrupt arrives at the CPU signalling the arrival of an echo. The count in the timer can be converted into distance using a known speed of sound.

#First Award - Junior Engineering Technical Society
Honorable Mention - Acoustical Society of America

ALGEBRAIC INVESTIGATIONS OF KNOTS

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Knot theory is a rather obscure branch of topology. Although knots are geometrical, they are usually studied algebraically by using group theory to construct an algebraic representation of the knot.

In this research the group theory-crossover analyzation method of knot analysis was used. This method was developed by the author in previous research. This paper is mainly concerned with a purely algebraic investigation of knots. A proof is being developed which will show that any two knots can be combined algebraically using the algorithm outlined in the paper. Also a proof is being developed which will demonstrate that a composite knot made up of torus knots can be represented with exponential equations. It is known that torus knots can be represented exponentially. These equations can be directly related to equations with complex variables. This will form another link between topology and algebra.

It is felt that this research will greatly enhance the algebraic analysis of knots. This is very important in that it has been shown that DNA, certain polymers, and other microbiological agents regularly utilize knots to perform basic functions.

Artificial Intelligence - An Electronic Mouse

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PROBLEM: Create an artificial mouse with the ability to maneuver through mazes in a fashion similar to the characteristics of living laborotory mice.

HPYOTHESIS: This should be possible using integrated circuit logic for "intelligence" and small motors for locomotion.

PROCEDURE: The maze will be set up in a square unit array, with walls placed along the sides of the squares at random, creating a course with an entrance, exit, and numerous dead ends. By converting each wall in the mouse's square to a binary digit, the combinations of walls can be represented by different numbers, which the mouse responds to by moving in the direction represented. If the choice is possible, the mouse will pick one direction; the next time that same choice is available the mouse will go in the other direction, preventing the mouse from reversing its path or repeating a mistake. Circuits are built using TTL (Transistor-Transistor Logic) integrated circuits. Locomotion is provided by two small transverse mounted motors, allowing for forward motion and direct turns.

RESULTS AND CONCLUSIONS: The mouse was successful when tested as a circuit; the results of certain mazes could be compared to runs by real mice. Major differences noted are the inability of the electronic mouse to remember parts of the maze, a trait usually present in successive attempts by living mice. The living mouse also was earning a reward while the electronic mouse simply ran through the maze until it came out. Artificial reproduction of all of the mouse's habits is very complex but can be achieved in this simple degree of "intelligence" using modern computer technology.

OSIRIS

ORGANIZED SPECIES INVENTORY RETRIEVAL AND IDENTIFICATION SYSTEM

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OSIRIS is an acronym representing the words Organized Species Inventory Retrieval and Identification System. It is a computer data-based program that expedites animal records-keeping procedures in zoos and other captive animal institutions. The OSIRIS diskette SERIES is composed of three primary parts: OSIRIS I is a program for creating, storing and updating information concerning individual animals; OSIRIS II(A) is a program that enables the creation of a species file; and OSIRIS II(B) is a program that compiles and sorts data between all the animals in a particular species. Using the OSIRIS network, zoos are able to quickly gain access to any of their animal files whenever they desire and at minimal cost. The program provides for print out capability, also. Modem telecommunication permits all of the zoos in the OSIRIS network to share their information.

Over 350 independent programming hours have been spent on the OSIRIS diskette SERIES . It has received the approval of the International Species Inventory System (ISIS—a world-wide records keeping network) and the Minnesota Zoo. It has received outstanding recognition awards from each of the branches of the armed services as well as other awards at science fairs. The project is being financed by the author's parents.

A RECIPE FOR PI

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My project deals with devising a formula for pi using only high school algebra and geometry. I came up with a formula to calculate pi as accurately as I wished. By finding the areas of inscribed andcircumscribed polygons of a unit circle, I could find the approximate area of the circle or pi. By increasing the number of sides of the polygons, the value of pi became more and more accurate.

In the process of calculating this formula, I came up with several new ideas. First, I devised a new theorem with which I could formulate several recipes for pi. Then, I found a sequence of irrational numbers that, if carried to the limit would equal a rational number,2. I then found a general formula for a sequence of irrational numbers whose limit is any positive integer. I also found one sequence that approaches zero as N approaches infinity and another sequence $(6)(2^N)$ that approaches infinity as N approaches infinity; I proved that the product of these equals pi. In simple terms, my investigation works out a case in which zero times infinity equals pi.

A METHOD TO DETERMINE THE ROOTS OF NTH DEGREE POLYNOMIALS AND TO GRAPH THEIR CURVES

Morris, Daniell W., Childersburg H.S., Childersburg, AL
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The objective of this project is to prepare and present a concise program in BASIC that will find the roots of polynomials of Nth degree, to distinguish the field of the equation's curves, and to plot this portion of the graph.

The program had several difficulties. The first is the fact that there is no way to immediately find the roots of polynomials of degrees higher than two. A convergence method must be used which is not exacting. A second problem was eliminating known roots from the equation, eliminating repetition. To accomplish this, a synthetic division was used to withdraw that factor from the equation. Unknown variables may not be incorporated in a BASIC program, so constants had to be separated from those variables. The first derivative of the equation was used to find the upper and lower limits of the X axis and the Y axis. These roots showed the location of the X values of curve changes, and substitution allowed evaluation of the Y values of the curve changes. Scaling the graph to fit the CRT was the only remaining problem.

A program was devised that would find the roots of any polynomial equation, provided there are no more than two imaginary roots. Further studies are under way to overcome even this. The first derivative of the equation is also solved for zeros and the graphic coordinates of inflection points are found.

#SPEECH SYNTHESIS, RECOGNITION, AND AN INTRODUCTION TO SOME

Castel, Gerardo J., North Marion H. S., Sparr, FL. 32690
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Can speech synthesis and recognition be programmed on software suitable to inexpensive computer hardware, such as the Sinclair ZX81, connected to an amplifier and a microphone? This challenge was undertaken by developing a machine language program, herein described as "Software Operated Mouth and Ear" (SOME). It is a combination of Z80A machine code routines, organized specifically for the analysis of voice inputs and their reproduction.

In spite that the SOME software produces a low speech quality with limited vocabulary for recognition, and requires considerable memory array for word storage, the required hardware (ZX81, amplifier, and microphone) is assembled into a very compact and relatively inexpensive set-up. Presently work is being done for improving speech quality. A built-in two-way communication array makes this software a versatile one. It is so demonstrated in conjunction with a handicapped wheelchair and other related uses.

A speech wave analysis program was prepared to produce graphic data of speech patterns, with an indepth report on speech synthesis and recognition.

#First Award - IEEE Computer Society
First Award - Patent Trademark Office/U.S. Department of Commerce/
Patent Office Society
Third Award - Institute of Electrical and Electronics Engineers, Inc.
Honorable Mention - Acoustical Society of America
Honorable Mention - Atari, Inc.

INVESTIGATIONS OF TWO VERSIONS OF THE EUCLIDEAN ALGORITHM

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My project investigated two versions of the Euclidean Algorithm, which is a method for finding the greatest common divisor (gcd) of positive integers and a solution to the corresponding gcd equation (a special type of Linear Diophantine Equation defined in my project). The two versions of the Euclidean Algorithm investigated were the Old Version of the Euclidean Algorithm (OVEA), the classicial algorithm developed by Euclid; and a New Version of the Euclidean Algorithm (NVEA) developed by W.A. Blankinship. A major objective of my project focused on determining the computer applicability of the two algorithms. Computer algorithms were developed for both versions of the algorithm. In computerizing the OVEA, I was led into a deeper sphere of my project. In this most important stage, I had to derive formulas for solutions to the gcd equation for two and greater than two values. To test the computerized versions, timings were taken after applying both algorithms to random samples of n-tuples of positive integers as n varied from two to ten. The analysis of these results indicated that while the NVEA was the version which was easier to compute manually, the OVEA with special formulas derived in my project was the better of the computerized algorithms.

#THE THEORY OF CENTRAL ANGLES

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The formula $C_a(n,m)$ was defined as the smallest central angle, θ^n_m restricted to $0° \leq \theta^n_m \leq 180°$, of the n-space figure in which θ^n_m is maximized for a given m vertices. The figure, furthermore, was defined to exist in Euclidean space and simplified by choosing vertices equidistant from the center. The objective of this study was to determine this general formula for all nonnegative integral values of n and m.

Specific and general cases were investigated by using several methods. Degenerate cases were cursorily checked. Regular simplices were used to determine $C_a(n,n+1)$. An upper bound for $C_a(3,m)$ evolved by relating the lateral surface area of a spherical segment construction to a sphere's surface area. $C_a(2,m)$ was developed. Specific cases of θ^n_m were given with emphasis on the use of the square antiprism.

The Theory of Central Angles was offered to explain the behavior of $C_a(n,m)$ and the difficulty in formulating $C_a(n,m)$ for $n>2$. The theory is as follows: $C_a(n,m)$, where n is an integral constant greater than two, necessarily has infinitely many terms. There exist, for any given n, an m sufficiently large that any formula having finitely many terms will not determine $C_a(n,m)$. Yet, for each given pair of n and m, there is at least one lower bound which is dominant and determines $C_a(n,m)$. This bound may be expressed with finitely many terms. The remainder of the paper was a qualitative commentary on the theory. Notably, the concept of "dominant lower bounds" was described.

#Fourth Award - General Motors ISEF

EFFECT OF X-RAYS ON MICROCOMPUTER COMPONENTS

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The purpose of my experimentation was to find out if x-rays would harm microcomputer components. X-ray damage could be caused from nuclear explosions, environmental x-ray and any other natural or man-made instruments. The air force has a Hardence Surveillance Program that has begun experiments to test Minute Man missiles against x-rays. And the survivability of the electronics if bombarded with x-rays and other rays. And if it is possible to use x-rays for a defensive purpose. In my experiments I used RAM and ROM microchips to test and they were Out of Operation. I used an x-ray machine made by General Electric and used it at 15 miliamps and 60-90 kilovolts at 1/5 seconds. I then tested a microchip, transistor and a vaccum tube all of which were IN Operation. They were tested at 60-90 kilovolts and 15 miliamps at 1/5 to 5 seconds. A circuit was built for the out of operation microchip to test for damage. The x-rays used on the tiny wires some as small as 1/40,000,000 of an inch wide. The x-rays alter the atoms and either disconnect them or render them unconductive. I therefore conclude that the RAM microchips are harmed and permanently damaged by the x-ray. And transistors and vacuum tubes survivability is greater than the chips tested; however, they can be damaged by x-rays, but at a higher damage.

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THE MOBIUS UNIVERSE -- 2D WITH A TWIST

A Mobius band is the object that results when a strip of paper is given a half twist and the ends joined together to make a band. If a line is drawn along the surface the line will extend over both faces of the band without crossing over an edge. The band's edge will behave in the same manner should one draw a line along it. This proves it to have only one surface and one edge. A strip of paper given any odd number of half twists and joined will result in a Mobius band. When a strip of paper is given any even number of half twists and joined it will have two surfaces and two edges.

The purpose of this project is to study the Mobius band, what occurs when a Mobius band is cut a different number of times, and how this compares to cutting two surfaced bands.

Paper models of Mobius bands were made with given numbers of twists. They were then cut longitudinally and resulting patterns were observed. These patterns were compiled into two theorems. One theorem predicts the results of cutting two-surfaced bands, the second predicts the results of cutting Mobius bands. Results of each depend on the number of initial twists and cuts. Both theorems predict number of bands, number of surfaces, number of edges, length width, number of twists, types of knots, and type of linkage resulting.

STEREOSCOPY

Um, Donald Donghoon, Mohawk Jr-Sr H.S., Bessemer, PA 16112; 537 South Main St., Bessemer, PA 16112.

This project, "Stereoscopy", deals with the process of producing and viewing two slightly dissimilar two-dimensional images of an object so that the eyes will perceive a three-dimensional image. There are many methods for this process, but all are based on the use of some sort of a stereoscope that will simulate normal binocular depth perception by forcing each eye to perceive only its corresponding two-dimensional image.

Furthermore, this process was applied to the computer (Apple II+/48K) to generate the three-dimensional images of a function F(X,Y) and function F(X) that was rotated around the X axis. Unlike the conventional 3-D graphing programs, which will produce a mere picture of a function, these programs will provide the viewer with a more realistic model of a function. The other features of these programs include the arbitrary rotation around the X and Y axes and the removal of hidden lines.

This concept of stereoscopy cannot only be applied in graphing a three-dimensional function but also can be applied in many other areas: computer games, architectual designs, art, medical technology, photography, etc. The computer provides a convenient vehicle by which the effect of stereoscopy can be demonstrated, visualized, and studied.

CLOVERLEAF KNOTS: DO THEY CONFORM TO KNOT THEORY?

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Knot theory seeks to determine when two knots can be considered equivalent. Deforming one tube model of a knot into another will determine equivalency, but the failure of trial-and-error does not suffice to prove that two knots are nonequivalent. Invariants however, can determine equivalency.

Relations between one-dimensional paths in the complement of a knot develop relations. The relations in turn construct one invariant called a knot group. Comparison of the relations in the knot groups will distinguish knots.

The physical and mathematical manipulation of the relations of the cloverleaf knot, overhand knot, and their mirror images will show that the four knots can be considered equivalent. The overhand and cloverleaf knots can be deformed one into the other physically, (the same also applies for their mirror images); but the cloverleaf knot is not easily deformed into its mirror image. This shows the failure of the trial-and-error method, and the necessity of knot groups to determine equivalency.

The cloverleaf knot, overhand knot, and their mirror images can all be classified as being equivalent when the physical tests of the knots use homotopic generators. The mathematical manipulation of the relations of the knots are true mathematically, but only when order is respected in the equations. The knot group does not determine that the knots are indeed knotted, or completely distinguish them nonequivalent to the trivial knot, but does show the knots equivalent.

THE FOURTH DIMENSION

Steve Pierson, Minot High School, Minot, N.D.; 58701, 211 Souris Dr., Minot, N.D., 58701.

The purpose of my project is to test the possibility of the fourth dimension, to confirm that the tesseract is the major object of the fourth dimension and to find the hypersphere and hyperpyramid.

Using the facts and characteristics of the zero, first, second and third dimension, putting these characteristics on a chart, and finding the patterns of these characteristics, topologists have been able to find the characteristics of the fourth-dimensional major object and the fourth dimension itself.

To find any objects in the fourth dimension, you must always go back and look at the patterns in the other dimensions. So patterns play a very vital part in my project.

To find the hypersphere and hyperpyramid, find the characteristics of the similar objects in the first, second and third dimensions, and find the patterns of these characteristics. Putting these patterns together, I was able to find the hypersphere and hyperpyramid.

Six of the eight cubes of the tesseract are distorted because it is a fourth-dimensional object put into three-dimensional space. This can be further illustrated by putting a cube, the three-dimensional object, onto paper, the second dimension. The cube, like the tesseract, had to be distorted.

Many people will have a hard time imagining the fourth dimension but that is not uncommon since it is impossible for that fourth perpendicular line to exist in the third dimension, it can only be represented.

OPTICAL IMAGE PROCESSING BY COMPUTER

Cominio, John E., Satellite H.S., Satellite Beach, FL 32937;
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Since the advent of the computer there has been a tremendous amount of hardware designed and built to operate these machines. Disk drives, printers and modems are only a few. These devices, however, are all designed to interface from machine to computer. In recent times there has been a push to interface from man to computer. Voice synthesizers, light pens and joysticks are just a few examples.

The project presented here takes this man-computer interface one step further: to have the computer emulate part of the human body. In this case the eye. Although the device built is not nearly as complex or resolute as the human eye, it does show the basic principles involved in constructing such a device.

A 3-D COMPUTER GRAPHIC SIMULATION OF A CHEMICAL REACTION

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The purpose of this project was to investigate the utility of 3-D computer graphics to simulate a chemical reaction as an aid to understand the chemical mechanism. A computer program was written in the Graforth language and executed on an Apple II+ computer with 64K bytes of memory and a 5 1/4" floppy disk drive. The simulation provided insight as to how these molecules interact. 3-Dimensional computer graphics can be used to visualize objects from different perspectives. The stereo-chemistry of molecules is very important in determining how they bond. This 3-D simulation can allow one to see the possible sites of interaction. Although this project was related to the visualization of molecular interactions, the use of 3-D graphics has broad applications such as: automobile design, space flight, and numerous engineering problems.

COMPUTERIZED INFORMATION CONTROL: COMPUTERIZED MEDIA CENTER INFORMATION CONTROL SYSTEM

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No abstract received.

*DIFFERENT INTERNAL SORTING ALGORITHMS AND THEIR EFFICIENCIES ON VARIED APPLICATIONS

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Since there are many different uses for sorting and many different sorting algorithms presently in use, the purpose of this project was to determine the optimum sort for each of several applications.

This project was completed with extensive use of a PDP-11 computer owned by NCR corporation.

Pascal programs were written for fourteen different internal sorting algorithms. These programs were run on lists that were random, random with the middle ordered, totally ordered, ordered with the first element moved to the end of the list, ordered with the last element moved to the front of the list, and inversely ordered. Three different lengths of each type of list were sorted by each sorting program. The lists were the same from one algorithm to the next to ensure that the results of each sort were suitable for comparison with those of the other programs. In the case of random lists, five trials were averaged for each sorting algorithm.

Shellsort was found to be the most efficient sort on long semi-ordered lists while quicksort was found to be the most efficient on long totally random lists. Shuttlesort was the most efficient sort on short lists of all types.

The source used most frequently in this project was:
Lorin, Harold, Sorting and Sort Systems, Reading: Addison-Wesley, 1975.

*Second Award - General Motors ISEF

APPLE'S REVENGE ON RUBIK

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Using mathematical induction, I developed an original solution for Rubik's Cube. This year, I extended my project by teaching my solution to my computer.

First, I had to let the computer know how the cube is arranged. By assigning a number to each color of the cube (white=1, yellow=2, etc.), I could type these numbers in a specific order around the cube. The computer will keep track of each number seperately, thus defining the colors of all 54 colored faces of the cube. A long series of IF... THEN statements was used to locate the position of each piece of the cube. After finding the position of the desired piece, the computer will go through a series of subroutines, each representing the rotation of one face of the cube in a specific direction. These subroutines transfer the colors of each of the 54 faces that is affected, and then they output on the screen a different number for each subroutine. These numbers tell the user how to rotate the cube to solve it the same way that the computer is using. Starting at the top of the cube and working its way down, the computer puts each piece into place. After finishing the program, I added steps that will allow the computer to randomly mix up the cube and solve it. Whenever a mistake was encountered, because of incorrect typing, etc., I could correct it. The 28K program will now solve any arrangement of the cube perfectly in about 30 seconds.

VOICE SYNTHESIS WITH A HOME COMPUTER

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PURPOSE: The purpose of this project is to show how to produce or "mimic" speech using a microcomputer, and to use this capability in some applicable situation.
PROCEDURE: The procedure for this project consisted of the following four steps- OBTAINING THE MICROCOMPUTER, WRITING VOICE SOFTWARE, BUILDING THE HARDWARE, WRITING APPLICATION PROGRAM.
DESCRIPTION: The computer in this project does not synthetically produce a voice. Instead, it will "listen" to the operators voice and then reproduce a likeable version. The larynx in humans is being replaced by the TV speaker and the computer acts like the lungs. The computer-lung sends a voltage to the speaker-larynx. This voltage is directly proportional to the sound produced by the operator. This varying voltage is sent to the TV speaker causing it to vibrate, producing sound or the reproduction of the voice.
Once the necessary hardware and software were established to produce or "mimic" speech, this capability was used in such a way as to be beneficial in some practical aspect. An application program was written to simulate what some banks have been using with voice synthesis. In the system that the banks use, a person can call a certain number and hear, by computer voice, how much he or she has in a certain account. The application program does essentially the same thing except that the user types in a dollar amount and the computer then "says" this amount.

A TRS-80 MICRO-COMPUTER SIMULATION DESIGNED IN A 3-D PERSPECTIVE

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The purpose of this project was to design a complex adventure game and then find the programming techniques necessary to produce such a program within the confines of a small micro-computer. The result is DRAVENSKILL, an assembly-language program created to run on the TRS-80 Model I micro-computer. DRAVENSKILL is a total 3-D adventure game designed to take the player on a realistic journey to a world mutually created by the computer and my programming knowledge. The goal of the game is to search as many dungeons as possible and steal large amounts of treasure while fighting off fierce creatures. Different ranks are obtainable according to skill and difficulty level.

The program countains a huge world covered with such variables as mountains, lakes, towns, and forests, not to mention dungeons filled with treasure. Each dungeon has several levels to explore, each level countaining monsters waiting to take your life. Boxes of treasure can be found at random while searching these dungeons. Traps are also integrated throughout the program.

DRAVENSKILL countains all the programming neccesary to create a 3-D perspective of the dungeon rooms you are in. Each dungeon is totally randomized at the beginning of the game to keep experienced players from being able to memorise the game each time they play. Each player has several weapons to utilise in order to ward off attackers. All data for character survival is displayed throughout the game to keep players informed of the progress they are making. In all, DRAVENSKILL is a game that should keep anyone interested for hours at a time.

MICRO-COMPUTER BASED EXPERIMENTS OF THE MONTE CARLO METHOD

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Various statistical systems were examined through micro-computer based simulations using the Monte Carlo method.

Preliminary experimental programs were written to "flip" coins and "roll" dice. The results verified the basic probability theorems such as Bernoulli's Theorem of large numbers. Brownian movement was also successfully simulated on a computer.

A series of Buffon Needles experiments were executed to estimate pi. The value for pi was estimated with increasing accuracy as the number of trials was sufficiently large. Simultaneously, a value for pi has also been calculated by randomly throwing dots into a square which has been circumscribed around a circle.

Experiments were made on a computer to simulate a "rain of balls", to produce a curve similar to the normal distribution curve.

Simulations of the flipping of coins were extended to illustrate how binomial distribution, with a large number of trials approached the normal distribution curve, this procedure known as the De Moivre-Laplace Theorem. Experiments throwing 100 coins many thousands of times verified this Moivre-Laplace theorem and produced a fairly accurate normal distribution curve.

Results indicate the effectiveness of the computer-based Monte Carlo procedure in evaluating complex dynamic systems.

MONTE-CARLO SIMULATIONS USING COMPUTER METHODS

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This project applies computer simulations to determine probabilities arising from two problems in mathematics. The first problem is: If a line segment is cut randomly in two points, then what is the probability that the resulting segments could be arranged so as to form a triangle? A second question, related to this problem, which is addressed is: what is the probability that a triangle so formed is obtuse? The second problem, commonly known as the Buffon needle problem, is: If a segment of fixed length (a needle) is randomly placed on a grid of parallel lines, then what is the probability that the needle crosses two lines on the grid?

Two programs were written for each problem. The first program simulates the process of partitioning a line segment and the formation of a triangle. The second program gives a graphic display of both the set of failures and the set of successes resulting from the simulation process. The first program simulating the trials in the Buffon needle problem presents a graphic demonstration of the process of placing a needle randomly on the grid of lines and the second presents a graphic display of the successes and failures.

The results establish that the probability of a triangle being formed is .25 and the probability that such a triangle is obtuse is approximately .68. The results from the Buffon needle problem establish that the probability of a needle crossing two lines is about .43 (for a needle of length 2 and a distance of 1 between the lines.)

COMPUTER SIMULATED STATICS

Timmerman, Rudy J., Wickes H.S., Wickes AR 71973
RR1 Box 170-A, Wickes, AR 71973

The purpose of my project is to write a computer program to simulate static experiments and to verify the results of the simulation with those of the actual experiment.

I began my project by picking out several static experiments to simulate and reading about them and how they work. With only four months experience in computer programming, I began to design the program. At first I wrote each of the four programs seperately and then rewrote them putting them together as one program. I then, to verify the results, compared the simulation's results to those of the actual experiment. Later I wrote the programs for simulations five and six, which deal with stresses on bridges, and then added them to the main program.

The results of my project are that the computer simulation gives you an answer rounded to the nearest one-hundreth where you could only get an answer on the actual experiment to the nearest ten. Also by pressing a few buttons on the computer you can have any size weight or angle you desire for the simulation. The computer can figure and give you the results in a split second where you must figure the results of the actual experiment by hand taking much longer.

The conclusion of my project is that computer simulations are a practical, accurate, and very educational way to experiment with statics. I also conclude by looking at simulations five and six that in the future we may have computer aided designing of bridges.

PHYSICS

EFFECTS OF PHASE SHIFTING AND DISTORTION ON A SOUND WAVE

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A sound wave can be altered by using a phase shifter or distortion. To determine how much effect phase shifting and distortion would have on a sound wave, testing was done with an oscilliscope. The phase shifter was set at different levels of speed and regeneration. Photographs were taken of the individual settings. Using these photographs, the sound waves were plotted on graph paper and compared. Wavelength and amplitude measurements were also calculated and compared. It was determined that wavelength was not significantly affected by phase shift or distortion. Amplitude varied with the particular settings. A high speed setting coupled with high regeneration usually produced high amplitude. Distortion also caused an abnormally high amplitude reading to occur. Wavelength, however, was not significantly affected by distortion. Varying speed and regeneration mainly caused changes in the amplitude readings.

#THE ADVANTAGE OF A RADIALLY STRESSED MEMBRANE AS A SOUND-LIGHT INTERFACE

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Purpose/Applications: A sound-light interface is achieved by reflecting a laser beam off a membrane which has been radially stressed and induced with single acoustical tones and grouped tones. One of the applications of the interface is instrumental tuning. An accurate method was to tune for the absence of fluctuation in pattern shape. This fuctuation happens because of interference between the two waves (base, and instrument).
Hypothesis: Tension areas on a membrane are in resonance with one tone. This makes each tone and each combinatin of tones' pattern unique for a relation of tensions in a membrane. Monostressed membranes yield circular patterns. Variations occur with more tensions. Duplicable conditions result when relative tensions are recorded. Tuning and voice analysis are therefore feasible.
Procedures: Resonance indication is measured by the size of the pattern through frequence scan. Single tone patterns are photographed and interpreted in size verses frequency.
Conclusion: The membrane was induced with tones and a complex pattern for each tone group was shown. The pattern would be circular, if not for several tensions interacting on resonance. A wobbling pattern is prevelant unless resonance occurs in a large area of the membrane. All patterns are therefore variations of the basic circular pattern. The conclusion is that this interface is a valuable tool for tuning pure tones and comparing tone groups (possible voice analyzation).

#Second Award - Acoustical Society of America
Third Award - Society of Photographic Scientists and Engineers
Fourth Award - General Motors ISEF
Honorable Mention - Eastman Kodak Company

DIRECT DATA TRANSMISSION VS. FREQUENCY MODULATED DATA TRANSMISSION

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For my project, I used an integrated circuit timer clock as a data (pulse wave) source, and a binary coded decimal two digit counter as the data register. I experimented with two methods of conveying the pulses from the clock to the counter in the form of a beam of light: direct signal transmission and frequency modulated data transmission. The transmitting light source was a light emitting diode (L.E.D.) and the light receiver was an FPT-100 phototransistor, with a strand of crofon optical fiber connecting them. I built and compared these two systems (the F.M. system is on display) on the points of cost, complexity, power consumption, reliability, and transmitting distance. From my experiments, I found that the frequency modulated system was less reliable than the direct system, though it was more complex, cost more and drew more current. The frequency modulated system did transmit farther than the direct system, but the cost, power draw and reliability of the direct system make it the superior. In reality, though, the specific application of such a system determines which would be superior. Looking back, one of my major problems was the lack of a powerful, yet controllable light source. The L.E.D. does not have an intense enough, or even a focused output. In future experimentation, I plan to use either lenses and L.E.D.s, or possibly a low power LASER.

COMPUTER GENERATED PLANETARY POSITIONS AND ORBITAL PATHS

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A computer program was written to see if the positions of each planet can be calculated for different time periods, using Newton's laws of motion and gravitation. From Newton's laws, $F=Gm_1m_2/s^2$ and $F=ma$, so $a=Gm_2/s^2$. From basic physics, $\Delta s=v\Delta t+\frac{1}{2}a\Delta t^2$ and $\Delta v=a\Delta t$, for a given increment of time. Thus, given the positions of the planets in x, y, and z coordinates, the velocities in x, y, and z vectors, and their masses, Newton's laws can be used to predict the new positions of the planets for each interval of time. The results initially generated by the computer were significantly in error. It was found that the error was reduced by using smaller increments of time. The final results were very accurate. The computer runtime necessary for such accuracy was four minutes for each day of planetary motion. Time could be reduced at the expense of accuracy, or a larger computer could be used to speed up the calculations. The final results showed that Newton's laws of motion and gravitation can be incorporated into a computer program which can predict the planetary positions with reasonable accuracy.

ATTRACTION OF LIQUIDS TO STATIC ELECTRICITY

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This project involves several different types of liquids that are attracted to a source of static electricity. In a water molecule, there is an imbalance in the number of protons. This imbalance of positively charged particles causes molecules to be polar. In other words, the electrons in the covalent bond between the Hydrogen and the Oxygen atoms will spend more time on the Oxygen side of the molecule, thus causing it to be slightly negative. It has been shown by others that an electrostatic source will attract or slightly bend a stream of water. This project set out to test if this attraction was particular to polar molecules. Several liquids were tested, the results were that most liquids will be attracted to a static electric source, whether they are polar, non-polar, ionic, or covalent.

THE MAGNETIC FIELD: A USEFUL COMMUNICATIONS MEDIUM

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The approach was to design and build a special electrical transformer that has a five foot diameter air core secondary winding and a two inch diameter air core secondary winding. Audio signals from a high power audio amplifier were fed to the primary winding to produce a strong magnetic field which was picked up by the portable secondary (receiver) winding. The secondary winding was connected directly to a pair of headphones for subjective analysis and later to a voltmeter for quantitative measurements. Quantitative results were corrected for instrumentation error, plotted on graph paper and analyzed.

#OPTIMIZING OPERATIONAL PARAMETERS OF A CARBON DIOXIDE LASER

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The purpose of this research was twofold; first, to perfect the existing laser system, and second, to determine the most cost effective system configuration. As a result, the system became more reliable and less difficult to operate. The data collected was reproducible for verification.

Final laser system configurations included: copper tubing with compression seals used throughout the gas supply system; discharge at 24Kv through the plasma tube; a center electrode in the plasma tube to stabilize the discharge pattern. The copper tubing was used because the rubber tubing leaked excessively, compression seals were also used due to the difficulty of producing a usable seal with the flare fittings. The power supply was set at 24Kv due to the more intense discharge, and the greater degree of stability attained in the higher voltage system. The center electrode was utilized because it allowed for longer plasma tubes, and increased discharge stability.

Data collected indicates that the mirror which is best suited for lasers desired to work in the class IV range (.5 watt and above) is the zinc selenide mirror. This mirror can handle high power (up to 100 watts) which allows the researcher to design and construct a larger laser with this mirror at a later time. This mirror also resists thermal runaway which could result in damage to the mirror itself. Thus for researchers working with or needing to use a high energy infrared beam, this would be the mirror recommended for their use.

#First Award - Vacuum Technology Division of the American Vacuum Society
Second Award - Optical Society of America
Second Award - United States Navy
Third Award - General Motors ISEF

A BROADBAND GRAVITATIONAL RADIATION DETECTOR

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In 1916, Albert Einstein predicted that there propagated through space, pockets of curved space, or gravitational waves. Since that time, physicists have attempted to detect these waves, but without success. This was because until recently, the technology had not existed to build a detector sensitive enough. In the last fifteen years, scientists have built large resonant drums to detect gravitational waves. But these detectors are restricted in their view of the gravitational radiation spectrum.

I designed a broadband gravitational radiation detector which uses a laser type interferometer. This detector uses a Michelson type interferometer to detect movements in the mirrors due to gravitational waves. Instead of moving the mirrors apart to increase the sensitivity of the device as has been done before, my design bounces the laser beam between the mirrors to amplify displacements due to a gravitational wave. The device designed utilizes a charged-couple device to monitor the interference pattern produced.

In the course of the project, a simplified model of the design was constructed in order to ascertain any possible sources of interference such as photon shot noise and blooming that could affect its performance.

It was found that theoretically, various sources of gravitational radiation would be detectable by my design.

#TIP VORTEX PROPULSION/A NEW APPROACH

Santos, Jonahtan, Bowie H.S., Bowie, MD 20715
2902 Tapered La., Bowie, MD 20715

The tip vortex is a tornado-like disturbance which is formed by the lower pressure lift zone drawing in the higher pressure air around the wing tip. I was curious to research possible ways to utilize the vortex instead of wastefully trying to eliminate it.

Researching this, I read an article on the unusual outstretched wing-tip feathers on larger soaring birds, and how those feathers detect the vortex for propulsion. I started my project with the idea of simply designing similar fins to be applied to the aircraft for the reduction in fuel consumption.

After 3 months of research in a home-made wind tunnel, I determined that this type of system would be inefficient and impractical due to the fact that the sails (except the first) lie in the turbulent wake of the sail before it. I then devised a way to incorporate the several separate fins into a single lifting surface. The technique to place this single sail at its most efficient angle of attack around the 3-demensional vortex was experimentally derived.

My concluding experiments determined that the "mono-sail" produces increased flight efficiency of 27 percent.

#First Award - General Motors Corporation
First Award - General Motors ISEF
First Award - Glenn T. Seaborg Nobel Prize Visit Award
First Award - Gulf Oil Corporation
First Award - National Aeronautics and Space Administration
First Award - National Association of Rocketry
First Award - Patent Trademark Office/U.S. Department of Commerce/ Patent Office Society
First Award - United States Air Force
First Award - U.S. Department of Energy
Second Award - American Association of Physics Teachers
Second Award - American Patent Law Association
Second Award - United States Army
Third Award - American Astronautical Society

LIGHT UP MY LIFE

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The purpose of my experiment was to determine when, if ever, does it take less electricity to keep a light on than it does to turn it off during a certain time period and then on again, and to determine the amount of energy used in turning a light on. To accomplish this, I first hooked up an incandescent light bulb to a kilowatthour-meter, and I turned the light on for certain time intervals in order to establish constant measurements for energy consumption. Then I varied the amount of time that the light was off, to achieve part one of my purpose. Next, I varied the number of times that the light was turned off, to find the watthours needed to turn the light on once, and the time that the light remained off before being turned on again, to see whether cooling the light bulb affected the energy needed to turn it back on. I concluded that leaving the light on always consumes more electricity than turning it off and then back on again. I failed to achieve the second part of my purpose because I found that a warm light bulb consumes less energy than a cold light bulb does when it's being turned on.

#RESEARCH,DEVELOPMENT,AND EVALUATION OF DIAMOND-LIKE AMORPHOUS CARBON (a-C:H) THIN FILMS AS ANTIREFLECTIVE COATINGS FOR SILICON SOLAR CELLS

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There is considerable interest at present in the development of novel semiconducting materials,with the goal of establishing their potential usefulness in future device applications. This project was undertaken to determine the physical and optical properties of a material classified in the family of organic polymer films. This material is carbon in the form of a thin amorphous film.

Semiconducting films of hydrogenated amorphous carbon (a-C:H) were prepared via the D.C. glow discharge of acetylene at deposition temperatures between 25°C and 375°C. The optical and physical properties of these films were then measured.

Amorphous carbon is favorable for a wide variety of applications including antireflective coatings on silicon solar cells and antiglare coatings for windows and optical instruments. When a-C:H coatings were applied to silicon solar cells,an increase in efficiency of 68.29% was achieved. As a result,smaller arrays may be used to substitute bulkier ones. Amorphous carbon's hardness also proved favorable in protecting the brittle solar cells from natural hazards,thus eliminating the cost of cell maintenance and replacement. When compared to other commonly used films for other applications,a-C:H proved superior.

As a result of the properties displayed by a-C:H films, one arrives at the conclusion that this material holds much promise in the field of device and commercial technology.

#First Award - American Association of Physics Teachers
First Award - Gulf Oil Corporation
First Award - U.S. Department of Energy
First Award - U.S. Navy/U.S. Marine Corps/London International Youth Science Fortnight
First Award - Weizmann Institute of Science
Fourth Award - General Motors ISEF
Honorable Mention - United States Air Force

TIME TRAVEL

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Time. Have you ever wondered what it would be like to see into your future or change something in your past? Is it at all possible or is it just a fantasy of someone's wild imagination? Not all of these questions can be answered, but a few pose some amazing solutions.

Man's total concept of time has changed drastically since the turn of the century. When Albert Einstein burst onto the scene with his concepts of relativity, many scientists were shocked. Yet, today many of his theories are accepted as scientific fact. Along with these are some of Einstein's perplexing theories dealing with time.

Time is no longer viewed as being constant. No one can truthfully say that there is an "absolute time." It all depends on the observer's point of view, or simply stated, is all relative to the observer.

One of the major factors present when dealing with time is light. It has been proven that as you approach the speed of light, time is altered. Light can also be warped by gravity. Thus, gravity affects time. The black hole is discussed as a primary object of time travel in this case.

Using these, among other theories, my project tries to explain how man may someday be able to travel through time. Not only are known theories stressed, but some new discoveries on time travel and time machines are presented.

#WAVELENGTH ISOLATION USING BIREFRINGENT POLARIZATION

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The purpose of my project was to study how colors are isolated (eliminated or transmitted) by combining linear with birefringent polarizing filters and to ascertain if there were practical applications.

My apparatus consisted of a homemade focusing rail with a shielded box light source at one end. Light emerged from a slit in the box and passed through a convex focusing lens, a vertical linear polarizer, a filter consisting of experimental birefringent material, a rotatable horizontal linear polarizer (the analyzer), and finally through a diffraction grating which projected the resulting spectrum on a screen where I could analyze and photograph it in my dark room, using my 35mm SLR camera with a 50mm reversed lens.

Experimental tests of various birefringent materials disclosed that the transparent plastic wrappers from a certain brand of cigarettes gave the most consistent results.

I learned that different thicknesses of the birefringent material isolated different wave lengths. I was able to block or transmit nearly all colors of the visible spectrum by using varying thicknesses of 1 to 9 layers and by rotating the analyzer.

I designed a computer program to accomplish the mathematical calculations and to display the results.

More significantly, I was able to design and build a prototype for a variable color filter system for cameras which may prove to be more versatile and less expensive than the glass filters presently marketed.

#First Award - American Patent Law Association
Second Award - Society of Photographic Scientists and Engineers
Honorable Mention - Eastman Kodak Company

NUCLEAR CLOUD CHAMBER

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This project is designed to trace the trails of high-speed atomic particles and to make the trails of these atomic particles visible by means of pressure, condensation and re-expansion of a colored liquid.

This apparatus consists of two glass jars with a hole in the side of each and a smaller hole in the bottom of one of the jars. These jars should be connected by soldering the rims of the two lids. (The lids should have the centers cut out with copper screening in between). In the hole of the bottom jar, tubing with a balloon on one end and a compressed air source on the other should be inserted, with the balloon on the inside of the jar. In the side hole of the top jar insert a cork with a radioactive source. In the top hole of the same jar a screw and nut is inserted. Twelve to forty volts should be connected to the apparatus by means of wires connected to the top and the rim of the apparatus. Resulting from the process by which the apparatus works, the trails of the atomic particles can be seen.

The significance of this project is that it detects nuclear or atomic particles. Because it does this, it can be used in many ways in science. For example, this apparatus was concerned with the study of the unknown ionizing properties of uranium and today is used to detect cosmic rays in the atmosphere. The nuclear cloud chamber is extremely important to modern science.

#CURRENT MODULATION IN THE PULSED ARGON-ION LASER DISCHARGE

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This is an investigation of the phemonemon, factors affecting, and the causes of current modulation in the pulsed argon-ion laser discharge. If the amplitude of the modulation varies inversely as tube pressure and occurs only at high discharge currents, it may prove that the modulation is caused by the plasma pinch effect. The pinch effect, which may be responsible for the modulation during the main part of the current pulse, is calculated to occur at discharge currents of 30A or greater. The modulation occurred only when employing the 1 uF discharge capacitor and only at the upper and mid-trailing edges of the current pulse. The amplitude of the modulation was varied to a greater degree at the lower-trailing edge than at the upper-trailing edge. In addition, modulation frequency increased at the lower-trailing edge of the current pulse. The data suggests that the modulation does occur in the laser discharge, varies inversely as tube pressure and occurs only at high discharge currents. As large currents are needed to cause the modulation, these findings seem to indicate that a cycle of plasma pinch and destruction of the pinch is responsible for the modulation. Since the frequency of the modulation is lower at the upper-trailing edge of the current pulse, it seems that ion-acoustic waves are present as a cause of the modulation during the early part of the pulse.

#First Award - Optical Society of America
Third Award - General Motors ISEF

THE EFFECT OF GRAVITATIONAL and CENTRIPETAL ACCELERATION ON LIQUID SURFACES IN UNIFORM CIRCULAR MOTION

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When a liquid is in uniform circular motion, the surface forms a perfect paraboloid. There are many applications for this. One application is making extremely low cost, highly accurate parabolic mirrors. As a container was in circular motion, plaster of paris was added and allowed to dry while in motion. The plaster formed a rough parabolic base. Over this base, a polymir was added and then was put into motion. The polymir hardened in twenty four hours. The resulting object was a parabolic mirror which cost approximately $2.00 to make. If the mirror was store bought, it would cost about $550.00. A parabolic telescope was built using a mirror made by this process. The telescope proved to be very effective.

This process can also be used to calculate the acceleration due to gravity. A light source, which is for all practical purposes dimensionless, was suspend over the liquid which is in circular motion. The image of the light source was found by focusing it with an eyepiece which has a focal length of one millimeter. By measuring the distance from the mirror to the light and the mirror to the image, the focal length can be calculated. A formula was developed which showed that the focal length of the acceleration due to gravity. By substituting the focal length, the acceleration due to gravity can be calculated. Other applications include; molds, lenses, solar collectors and mirrors.

THE PHENOMENON OF WATER DROPLETS

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The general purpose of this experiment was to determine the floating mechanics that allow drops to float. In the experiments I used varied equipement such as; a heat lamp, signal generator, 12 volt electrical supply, 1000 volt coil, speaker, and a supporting stand. The reason for the equipement was to control the standing waves, temperature, and electrical field change.

The life time of the floating drop can be increased from about a few seconds to several seconds, by adding liquid detergent in a ratio of 3:25 to water. The remarkable phenomenon that has been discovered is that the drop can be made to last up to several minutes by vibrating the container of water.

Through my experiments I derived an equation that would determine the lifetime of the drop by knowing the gap size between the surface and the drop, and the initial life time on a calm surface. The equation that I derived is as follows; $T=t(G/g)^3$

I derived a theory that says that air is trapped under the drop. This enables the use of the equation to prove it. Since the lifetime of the drop depends on the rate of air escape, the lifetime depends on the cube of the gap's width.

I was to prove that electrical charges of any type have no constructive ablity to improve the lifetime.

#ENERGY ENHANCEMENT OF SOLAR PONDS UTILIZING POLYMERIC SURFACE STRATIFICATION

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The non-convecting solar pond concept is dependent upon establishing and maintaining a series of non-mixing gradient brine layers. A maxium heat output can be achieved under these conditions. However, polymeric layer stratification replaces the static non-convective zone layering of the traditional salt gradient pond by utilizing a transparent layer of viscous or gelatinous polymer gel. The purpose of my study was to determine what type of polymeric surface or interface thickener is best for use as a viscosity stabilizer and energy enhancer in solar ponds.

Experimentation consisted of construction of test ponds and analysis apparatus and repetitive testing of each of the below listed experimental criteria.

The tests conducted on the various polymers were mainly concerned with the following factors: 1. Viscosity interface stabilizing and wind-induced, wave-reduction potentials. 2. Buoyancy properties. 3. Light absorbancy and temperature retention potentials. 4. Heat tolerance and evaporation inhibition. 5. Determination and optimization of effective operating depth and width of the stabilizers. 6. Stability. 7. Cost comparison and application of the thickeners versus their capabilities for prolonged use.

My results indicate that for the conditions and processes experimentally analysed, a 37:63 ratio mixture of Cyanamer P-26 a Acrylamide Copolymer and Cyanamer P-250 a Polyacrylamide (both manufactured by American Cyanamid) exhibited optimum experimental performance. Commercial application appears both feasible and cost effective.

#Honorable Mention - Gulf Oil Corporation
Alternate Award - U.S Department of Energy

#SPECTRAL FINE STRUCTURE OF THE SUN'S SURFACE

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The sun is of great importance to scientists studying the physical processes occurring throughout the universe because the sun is a star itself, and it is believed that the very same reactions occurring in our sun occur in the majority of other stars. The light emitted from the sun's surface can give many clues as to exactly what happens on the surface and inside the sun. Theories and methods for interpreting the formation of sunspots and other processes of the solar surface fall into the area of magneto-fluid-dynamics. Using the Zeeman effect of spectral line broadening and splitting, the magnetic fields that form the sunspots and contour the ionized fluid of gasses on the sun can be measured from earth and conclusions can be drawn.

My goal was to make a spectral study of the whole solar disk, showing where a particular wavelength of light is strongest, in addition to studies of solar flares and magnetic fields surrounding sunspots.

I used visible-light emission spectroscopy to image each phenomenon in one wavelength of light and to study the emission spectra to see the effects of magnetic fields on the radiation distributions. I have constructed an array of instruments that I used to examine sunspots, solar flares, and faculae and also to record the radiation distributions. This array includes 1) a spectroheliograph with the images digitized and stored on a home computer; 2) a six-inch, f/8 Newtonian reflector telescope with a mirror I ground and polished myself; 3) a telescope pier and tracking mirror system to track the sun during observation.

The period of time from the beginning of active research to the completion of the project was approximately eight months.

#First Award - American Astronautical Society
Third Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration
Honorable Mention - Optical Society of America
Honorable Mention - Society of Photographic Scientists and Engineers

COMPARISONS BETWEEN AERODYNAMIC EFFICIENCIES OF FOUR MODERN CARS

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This project deals with the aerodynamic efficiency of four different models of cars. There were two different areas of experimentation that were covered in this project. The total resistance (measured in grams) of each model at various wind speeds was the first area of experimentation. The air flow over the models, and the cars' points of least and most resistance to wind, was the second area of experimentation.

Using several methods, it was found that the Ford Escort had the least average total resistance to air, and therefore it was the most aerodynamically designed car. The Plymouth Horizon came in second to the Ford Escort in aerodynamic efficiency. The Datson 280ZX came in third, and the Omni)24 came in last in aerodynamic efficiency. It was also found that there was a pattern that all the cars followed in their total resistance. At very low speeds the cars had very low total resistance, but as the speed increased, the resistance suddenly increased very rapidly in proportion to the speed. As the speed increased more, the resistance once again increased at a lower rate in proportion to speed. Finally, as high speeds were reached, the resistance increased drastically in proportion to speed. It was also observed that there was a corelation between all the cars' EPA gas mileage and their aerodynamic efficiency.

#HOLOGRAPHIC INTERFEROMETRY: MEASUREMENT OF PRESSURE-MEDIATED NANOMETRIC MOVEMENT AS APPLIED TO INDUSTRIAL BEARINGS

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The purpose of this research was to develop a holographic interferometry system and environment. This technique was used to measure the amount of nanometric movement in heavy duty roller bearings under weighted stress. Bearings were selected as test specimens because of their myriad of applications in engineering, the military, and the automobile and steel industries. The technique was implemented by first producing a hologram of the specimen. A hologram is a means of recording the actual light waves of a given object, then releasing the light waves at a later time. Modifications were made in the components comprising the system: the vibration isolated table, anti-vibration shutter system, optical system, and base and towering jigs. External and internal environmental vibrations and uncontrolled light were eliminated. Double exposure holographic interferograms were analyzed by setting an interferogram in front of the same reference beam used during the recording. The object recorded fringes indicating where stress had occurred during exposure on Kodak SO253 holographic film. By inserting the number of fringes N into the formula $M=N(W)/2$, where W is the wavelength of the laser (632.8nm), the amount of movement M is found. The results show that the holographic interferometry system was successful in documenting pressure-induced nanometric movement in a heavy duty roller bearing which was interpretated to show a movement of 632.8nm to 1265.6nm with 2000 grams of weight. The data has initiated one bearing manufacturer to re-evaluate its current concept of Cagerol type bearings. The method has proved to be a novel means of understanding bearing stress deformation.

#First Award - Eastman Kodak Company
First Award - General Motors Corporation
First Award - Society of Photographic Scientists and Engineers
Second Award - General Motors ISEF
Honorable Mention - Optical Society of America

#THE CONSTRUCTION, OPERATION, AND ANALYSIS OF A MICROPROCESSOR MONITORED COSMIC RAY TELESCOPE

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The primary purposes of this research were to design and operate a cosmic ray telescope and a microprocessor system to study cosmic radiation. The cosmic ray telescope consists of 2 Geiger-Mueller tubes connected to a coincidence circuit to give directional characteristics. A third tube was added outside of the detection plane and connected to an anticoincidence circuit to investigate shower activity. The microprocessor system consists of a Z80A CPU, a CRT (Cathode Ray Tube) display, 12K of static RAM, a keyboard interface, and a 1.5K operating system in ROM. The system was enployed monitoring the telescope. Proper operation of the telescope and microprocessor system was determined by a reproduction of the $\cos^2 \theta$ function discussed by Gould and Ives. The apparatus was then utilized in a study of factors affecting cosmic ray intensity by selective angle measurements and variations in intensity over a short period of time (generally several days). Results indicate that solar activity affects cosmic ray intensity. Also, other factors, which have not been determined, are involved. Further research may probe the nature of these factors.

#First Award - National Aeronautics and Space Administration
Second Award - American Astronautical Society
Fourth Award - General Motors ISEF

#GYROSCOPIC PRECESSION

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225 Man-O-War Circle, Cantonment, Fl. 32533.

__Purpose:__ Determine A. How certain variables (force, speed, diameter, weight of rotor) effect precession of gyroscopes. B. Practical uses for principles of gyroscopic precession. __Experiments and Results:__ Apparatus used for Experiment #1 was a gyroscope with outer and inner gimbal (PVC pipe) and rotor (bicycle wheel) allowing vertical and horizontal plane movement. With diameter and weight of rotor constant, rotor speed was varied and different forces applied to inner gimbal. Degree of precession averaged 21.25° for each ounce of force. Rotor speed had no effect on degree of precession, however, it did effect speed of precession. For experiments #2,3,and 4 apparatus was gyroscope consisting of rotating platform with me standing on platform holding rotor. With rotor speed constant, force was applied to move rotor from vertical to horizontal plane. Precession was recorded for each variable. Degree of precession with large rotor was 512° more than that occurring with the smaller. When rotor weight was varied precession was 140° (light), 780°, and 1220° (heaviest). When time for force application was increased (1 to 5 seconds) precession was the same (1220°) but took 3.5 seconds longer to complete. __Conclusions:__ Degree of precession is directly proportional to force applied*, rotor diameter and rotor weight. It remains fairly constant for given force regardless of rotor speed. It is same regardless of speed of force application. Speed of precession is directly proportional to force applied. It is inversely proportional to rotor speed.**

*Useful principle for control gyro

**Useful principle for stabilizing gyro

#Second Award - Marine Technology Society/U.S. Naval Institute

STRESS VS STRAIN

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The primary objective of this project is determining the Modulus of Elasticity, a ratio of stress to strain in aluminum, brass, copper and galvanized wire. This value is found through a process involving a homemade loading cell, strain gauge, bucket, weights and the material being tested, as well as other needed items. Data, cross-sectional area of the wire, its beginning length, strain gauge readings and the weights are recorded before and during actual experimentation. From these measurements values are calculated and then used to plot the stress-strain curve for that particular material. From the graph the slope of the line is found giving one the Modulus of Elasticity. Results obtained by this process have given values not coinciding with accepted values. This descrepancy may easily be explained. The material used in this project may not be a pure substance. Depending upon the numberous alloys the wire may contain, the measured values may or may not agree with accepted values. Since most wire is cast through a die, the cross-sectional area may not be a constant and also stress concentrations are likely to occur. These are just a few reasons as to why the values differ. The applications of this project are extremely vast. Architects, Civil and Mechanical Engineers as well as those in other occupations must rely upon knowing the Modulus of Elasticity to determine what materials can or cannot be used in certain objects such as bridges, buildings, cars, etc.

A STUDY OF THE THERMOGRAVITATIONAL THEORY OF HEAT TRANSFER

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As the world is faced with an oil shortage, which causes many negative economic effects, the public and scientific community should continue research for alternative sources of energy. I feel it is my responsibility to research at greater lengths for different solutions to this problem.

My purpose was to determine how and why the Thermogravitational or Envelope Theory of Heat Transfer worked. My hypothesis was that the majority of air will collect at the house's peak, allowing for an uneven heating. My hypothesis was based on the fact that hot air is lighter than cold air and will seek the highest point possible.

Methods used were the following: first, I heated the envelope house for thirty minutes, took temperature readings at various locations within the envelope and house. Secondly, I took infra-red photos of the house with exposures from one to ten minutes. Thirdly, I used a smoke path test. I observed the smoke path and took photos of the air movement. Fourth method used was taking air velocity readings of various locations during the heating process.

The first method proved my hypotesis correct with heat collecting at the peak, while other areas of the envelope were quite a bit cooler. The second and third methods also proved conclusive of my hypothesis. The fourth showed that air velocity dropped after the peak region cooled, also proving my hypothesis correct.

My overall conclusion is that the envelope theory does work but not as predicted. The air must heat the inner walls which heats the inner rooms.

#THE USE OF A SWIMMING DEVICE IN THE COMPARISON OF STRAIGHT AND CURVED STROKE PATTERNS

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The purpose of this project was to compare a straight stroke pattern to a curved stroke pattern. A device was built to test the efficiency of each stroke pattern. Two arms of this apparatus rotated against wire tracks which were bent to produce the two stroke patterns.

The apparatus was first tested, for each stroke pattern, lifting a 49.9 gram mass by the axle of the apparatus. The force required to lift this mass was multiplied by the distance lifted, and then divided by the time. The result, because the electrical input was constant, was the mechanical output for each stroke pattern.

Once the apparatus had been tested for its mechanical power output for a stroke pattern, it was timed swimming a distance of 130 cm. The speeds (using distance divided by time) of several trials were averaged together to find the average speed for each stroke pattern.

The resulting speeds were; 16.3 cm per second for the curved and 15.6 cm per second for the straight stroke pattern. The curved stroke pattern speed was faster, even though this stroke pattern had a smaller power output value. The speed, corrected by the mechanical output ratio of 1:1.33 (straight to curved), was 21.7 cm per second for the curved and 15.6 cm per second for the straight stroke pattern.

The curved arm stroke pattern, which is used by competitive swimmers, was the most efficient stroke pattern. This shows that maximum efficiency in the water is achieved by constantly moving still water molecules rather than those already moving with the motion of the arm.

#First Award - United States Army

THERMOELECTRIC COOLING IN A SEMICONDUCTOR

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Thermoelectricity is generally divided into two effects. The Seebeck effect is the conversion of a temperature difference into electricity. The Peltier effect is the reverse process. I concentrated on the thermoelectric cooling aspect.

For experimentation, I used a thermocouple made of semiconductor crystals. Two cylinders of Bismuth Telluride or Bismuth Antimony Telluride formed the legs of the thermocouple. These semiconductors had been doped so that one was P-type and the other was N-type. I measured the Seebeck coefficient, which is the thermocouple voltage divided by the temperature difference. I then measured the electrical resistance and thermal conductance of the thermocouple legs. I used the Peltier effect to cool one junction of the thermocouple by passing a current through the semiconductors. The temperature difference between the hot and cold junctions rose with current until a peak was reached, followed by a decline. This was due to the heat generated in the electrical resistance and the heat conducted by the thermal conductance of the semiconductors overcoming the heat pumped out by the Peltier effect.

The measured electrical resistance and thermal conductance were used in a computer program to calculate the temperature difference versus current for trial values of the Peltier coefficient. The trial values were entered into the program until the computer simulation matched the experimental data. This computer simulation of the cooling process not only gave valuable insight into the entire effect, but also allowed a determination of the Peltier coefficient and the relationship between the Peltier and Seebeck coefficients.

CAN ELECTROMAGNETIC FORCE FIELDS BE USED TO PROPEL AND ACCELERATE A VEHICLE

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My purpose was: To see if electromagnetic force fields can be used to propel and accelerate a vehicle. And to see which vehicle is the most effective. (1) Magnetic Attraction Vehicle (2) Charge Attraction/Repulsion Vehicle (3) Combination Magnetic and Charge Attraction Repulsion Vehicle.

The procedure for my research was: (1) Design and build three vehicles, and a system to propel the vehicles (2) Test the system for propelling the vehicles (3) Design and build a system for accelerating the vehicles (4) Test the system for accelerating the vehicles (5) Test each vehicle using one and two magnetic coils (6) Calculate the results

Assuming mass, friction, forces, and variation of the forces vary inversly with the distance the vehicle travels away from the force are constants, then force and acceleration acting on the vehicle can be measured in distance traveled along the track. Total average results for one coil/two coils were: (1) Magnetic Attraction Vehicle .766m/1.277m (2) Charge Attraction/Repulsion Vehicle .988m/1.427m (3) the Combination Magnetic and Charge Attraction/Repulsion Vehicle .876m/1.408m.

I conclude: Electromagnetic force fields can be used to propel and accelerate a vehicle. The Charge Attraction/Repulsion Vehicle was the most effective, followed by the Combination Magnetic and Charge Attraction/Repulsion Vehicle, and then the Magnetic Attraction Vehicle.

This system could be used to move heavy loads at high speeds, replacing the train systems and eventually even the trucking industry.

EXPLORATION OF SPACE BY RADIO ASTRONOMY

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This project dealt with two amateur radio telescopes. A solar radiometer was constructed first. The solar radiometer was composed of a four-bay Quad antenna, a Heathkit receiver, and an oscilliscope with VTVM for the recording system. Because the sun is a relatively easy source to receive, this is a good initial radio astronomy project. The main goal of this project, however, was to detect Jupiter, a hard and challenging source to receive. In order to receive Jupiter, the antenna had to have special characteristics for this small and relatively weak target. These antenna characteristics were narrow beamwidth, over 14DB gain, and feasible construction. A forty foot antenna consisting of one reflector, a half-wave folded dipole for the driven element and thirteen directors was chosen to detect Jupiter. The antenna (Yagi) was tuned for a frequency of 110MHz. The receiving system mainly consisted of an aviation band receiver. An ammeter was connected as the load across the output terminals of the integrator for maximum sensitivity. This served as an adequate recording system. The results were plotted on graph with respect to time. The signal strength rose above the noise of the receiver only when Jupiter was within the antenna beamwidth. These results show that Jupiter was definitely detected. The non-thermal radio signals from Jupiter were recorded on a cassette tape.

DOES THE MICROWAVE REFLECTIVITY OF LIQUIDS VARY AS A FUNCTION OF TEMPERATURE AND POLARITY?

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The study of the properties inherent in the reflection of microwave radiation by liquids necessarily focuses on those characteristics which determine the backscatter amounts of the incident energy. Although experimentation has been conducted by radar meteorologists to sufficiently account for attenuation by various water states in radar wavelengths, little extant data has been compiled for the interactions of other liquids and shorter wavelength emissions. Among these lower-energy emissions, the usual approximation methods used in radar meteorology such as the Rayleigh function are rendered useless, and new methods incorporating the temperature and electrostatic attraction (polarity) of the individual liquid molecules are required. This project investigates these two crucial factors governing the retransmission of microwaves by liquids.

Research into the effects of temperature and polarity on intransit microwaves entailed an understanding of the variables' respective dependence on the experimentally-determined values known as the dielectric constant and the dipole moment. The theoretical relationships between these values and microwave reflectivity suggested an indirect proportionality with respect to temperature and a direct proportionality with respect to polarity. Experimentation consisted of a combination of empirical calculations and laboratory analysis of microwave reflection by five liquids of differing composition and electrical orientation. The special characteristics of microwave-liquid interaction were evaluated for valid conclusions, and the resultant trend toward a more complex variable-reflectivity relationship was noted, along with avenues of approach for further extensive research.

FORCE FIELDS: A GRAPHIC COMPUTER-BASED SIMULATOR

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Force fields are a common phenomenon. "Force field" is a term from physics that refers to any region throughout which some force is acting. Around a light bulb, for example, there is a field of light.

Gravity, like light, is a force field that fades at the square of the distance. (When objects are twice as far apart, there is $\frac{1}{4}$ of the gravitational attraction between them.) Using Newton's laws and several other factors, the final expression that determines the change in velocity parallel to the x-axis of one body is $Change=K \cdot M2 \cdot M2 \cdot DX \cdot T/((R^{E+1}) \cdot (M1+M2))$, where K is a force constant, M1 and M2 are the masses of the two bodies, DX is the difference in their x-coordinates, T is the time interval selected, R is the distance between the bodies, and E is the exponent of the force law.

In the program, each body "moves" according to its velocity and the time interval. The effects of the "force" are then calculated using the equation above, which changes the velocity of each body. This process is repeated until a body can no longer "fit" on the TV screen.

This program has several applications. For example, the unsolved problem of more than two bodies can be approximated accurately. The effects of an outside body on the solar system can be simulated, or the motions of a binary or trinary star system can be anylyzed. Other forces, such as electromagnetism, can also be simulated by using this program. Even forces that have no physical analogs can be simulated, such as a force that "fades" at a negative exponential rate. The versatility of this program is only limited by the imagination of the person using it.

THERMAL INSULATING CAPABILITIES OF OUTDOOR CLOTHING

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Thermal insulation of clothing has been a major source of experimentation in the garment industry. Man is constantly looking for ways in which to protect himself from the environment.

The consumer should have some type of knowledge about thermal insulation of clothing. Factors such as weight, price, thickness of garment, and its contents should be considered before purchasing the garment.

The purpose of this project is to compare the heat retention capabilities of four different filler materials. The materials tested were goose down, polyester, cotton, and Thinsulate. A 30 cm^2 swatch of each material was made with a loft of approximately 4 cm.

When considering both the weight and heat retention capabilities, the Thinsulate provided the best insulation. It is also very inexpensive, though it is not widely available to the public at this time.

Down provided nearly the same heat retention, but the weight of the swatch was much greater than the Thinsulate.

Polyester is the lightest filler material. It, too, has relatively good heat retention.

Cotton was the lowest of the four swatches and is considered to be a poor insulation material.

#PRINCIPAL COMPONENT SIMPLIFICATION OF SATELLITE DATA FOR NONLAMBERTIAN SURFACES

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Meteorological satellites have a much wider look angle than Landsat and non-Lambertian reflectance patterns must be accounted for; these complex patterns are only now being measured and no way has been found to correct them.

The purpose of this project is to use principal component analysis to organize the many patterns into a few simple and understandable ones from which pattern predictions can easily be made from available information.

I built a machine using a photographic light meter to measure light reflection from various surfaces through 25 separate off-nadir and azimuth viewing angles for a light source zenith angle of 30°. Surfaces ranged from smooth to rough as well as fibrous surfaces with various orientations. From an unpublished paper I obtained an additional 7 patterns of agricultural surfaces measured in the field by NASA scientists. To remove the effect of average albedo I took the logarithm of intensity, then removed the mean of each pattern before doing principal component analysis.

Three principal components explained 89% of the pattern variance of all the surfaces, and for half of the surfaces over 80% of the variance could be explained by only two principal components. Using the first two principal components allowed separation and grouping of various surface types and provided a convenient continuum for forecasting patterns.

#First Award - National Aeronautics and Space Administration
First Award - National Oceanic and Atmospheric Administration
Second Award - United States Air Force
Fourth Award - General Motors ISEF

#A LABORATORY STUDY OF COSMIC RAY MUON INDUCED RADIOISOTOPES

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Positive and negative muons produced in the atmosphere comprise 63% of the secondary radiation detected at sea level. These can free decay or the negative muon can capture decay. A study of these processes is vital to better understanding weak force interactions. This was studied in two ways. The first part used a scintillation detector which was a plastic box with plates of plastic scintillator for light guides and filled with water. A chemical element was dissolved within this for the capture decay target material. To this was connected a photomultiplier tube and sufficient electronics to measure the muon capture decay lifetime. To determine the detector's efficiency, water was initially the only target. This indicated the water served well for the scintillation detector system. Ensuing use of heavy elements within the detector yielded results fitting proposed theoretical values well. A second experiment studied the conversion of atmospheric Ar to chlorine isotopes by muons. This was done by collecting Cl isotopes from rainwater via a chemical precipitation and placing the sample before a gamma ray detector which effectively measured Cl. Further analysis indicated the concentration of Cl in rainwater varied inversely with the size of the raindrop thus indicating the general nature of raindrop formation on aerosol particles. These two experiments provided important experimental data on current theories about the capture decay lifetime of muons in various elements. The rainwater also yielded data on capture decay products as well as providing for the measurement of raindrops.

#Third Award - General Motors ISEF
Honorable Mention - National Aeronautics and Space Administration

#COLUMNAR MICROSTRUCTURE GROWTH OF THIN METAL FILMS OBTAINED DURING VAPOR DEPOSTION

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When metallic thin films are formed by deposition such as by physical vapor deposition, columnar structure growth can be observed through the electron microscope. These thin films are quite different from slices of bulk materials. The microstructures of these thin films have important significance to the film's electromagnetic and light reflection characteristics. Thus, it is necessary to have a thorough understanding of the columnar structures so that reliability and quality of thin film products can be determined. An important example of applications is the silicon chip (integrated circuits), which consists of thin film coatings.

The objective of this study is to evaluate the feasibility of the microcomputer simulation model in studying the columnar growth of thin metal film obtained during vapor deposition. A simulation model and computer program with the "atoms" landing randomnly on the substrate surface has been developed. It is based on the Monte Carlo Method which consists of statistical experiments using random numbers.

Microcomputer simulation results clearly showed growth of columnar structures, which was observed by several scientists through the Scanning Electron Microscope. Results in simulation runs also indicated that direction of columnar structure growth is different relative to the incident angle when incident angle is not perpendicular to the substrate surface. The relationship between these two angles shown in simulation agrees with the Tangent Rule which was previously confirmed in electron microscope observations.

#Third Award - Vacuum Technology Division of the American Vacuum Society
Fourth Award - General Motors ISEF

#WIZZARD SKI - THE FASTER, LONGER-LASTING SKI FOR ARTIFICIAL SLOPES

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The coefficient of dynamic friction between conventional skis and snow is very low (0.05) due to the lubrication provided by a film of water between the ski and the snow caused by frictional heating. This effect does not occur with artificial slopes, which are supplied by Dendix Ltd, and consist of a matrix of brushes formed from PVC filaments. This leads to a higher coefficient of friction (0.13) and extensive ski wear. Preliminary tests on alternative ski sole materials pointed towards specialist polymers and samples of 15 (including pure and filled PTFE , acetal, various nylons and polyethylenes) were obtained. The load under a ski varies along its length and an analysis of the mean and peak loads per brush generated during skiing was used to define laboratory tests for measuring coefficients of static friction. Marked non-linearities were observed towards the peak load regions, caused by filaments buckling and thus causing ploughing in the softer materials. Wear tests followed using a rotating cylinder of Dendix filaments bearing on a test sample supported by a pair of scales to measure load. Skis soled with the seven most promising materials were subjected to field tests, both static friction tests on horizontal sections of the slope, and timed descents (to measure dynamic friction) on inclined sections. These tests showed that one material is significantly superior to conventional ski soles in both friction and wear, and comparisons between the results of field tests and laboratory work showed that peak loads per brush rather than mean loads should be used when estimating friction in this field.

#Second Award - General Motors ISEF
Third Award - American Association of Physics Teachers

ISEF PROJECT CATEGORIES

This preliminary list of Category Descriptions has been made up in response to the many requests for clarification in order to help students and teachers make category selections.

Category Descriptions:

The General Motors ISEF Grand Awards are given in twelve different categories. The categories and examples of the types of projects belonging to each are as follows:

Behavioral and Social Sciences: Psychology, sociology, anthropology, archaeology, ethology, ethnology, linguistics, animal behavior (learned or instinctive), learning, perception, urban problems, reading problems, public opinion surveys, educational testing, computer assisted instruction, artificial intelligence and games, etc.

Biochemistry: Molecular biology, molecular genetics, enzymes, photosynthesis, blood chemistry, protein chemistry, food chemistry, hormones, etc.

Botany: Agriculture, agronomy, horticulture, forestry, plant biorhythms, palynology, plant anatomy, plant taxonomy, plant physiology, plant pathology, plant genetics, hydroponics, algology, mycology, etc.

Chemistry: Physical chemistry, organic chemistry (other than biochemistry), inorganic chemistry, materials, plastics, fuels, pesticides, metallurgy, soil chemistry, etc.

Earth and Space Sciences: Geology, geophysics, physical oceanography, meteorology, atmospheric physics, seismology, petroleum, geography, speology, mineralogy, topography, optical astronomy, radio astronomy, astrophysics, etc.

Engineering: Civil, mechanical, aeronautical, chemical, electrical, photographic, sound, automotive, marine, heating and refrigerating, transportation, environmental engineering, etc. Power transmission and generation, electronics, communications, architecture, bioengineering, lasers, computers, instrumentation, hardware, firmware, and systems software design, configuration, construction and testing, etc.

Environmental Sciences: Pollution, (air, water, land), pollution sources and their control, waste disposal, impact studies, environmental alteration (heat, light, irrigation, erosion, etc.), ecology.

Mathematics and Computers: Calculus, geometry, abstract algebra, number theory, statistics, complex analysis, probability, topology, logic, operations research, and other topics in pure and applied mathematics. Computer application, software of a general quantative or algorithmic nature, etc.

Medicine and Health: Medicine, dentistry, pharmacology, veterinary medicine, pathology, ophthalmology, nutritioin, sanitation, pediatrics, dermatology, allergies, speech and hearing, optometry, etc.

Microbiology: Bacteriology, virology, protozoology, fungal and bacterial genetics, yeast, etc.

Physics: Solid state, optics, acoustics, particle, nuclear, atomic, plasma, superconductivity, fluid and gas dynamics, thermodynamics, semiconductors, magnetism, quantum mechanics, biophysics, etc.

Zoology: Animal genetics, ornithology, ichthyology, herpetology, entomology, animal ecology, anatomy, paleontology, cellular physiology, animal biorhythms, animal husbandry, cytology, histology, animal physiology, neurophysiology, invertebrate biology, etc.

Category Interpretations:

It is impossible to develop category descriptions which can be applied to any and all projects without some questions. In particular, the increasingly interdisciplinary nature of science and engineering means that many projects will draw upon more than one field. To determine a project category, it may therefore be necessary to identify the primary emphasis.

For example, limnology is defined as the scientific study of the physical, chemical, meteorological, and biological conditions in fresh water. A project in limnology would thus have to be considered from the point of view of its primary emphasis (physics, chemistry, etc.) to be placed in the appropriate category.

Below is a list of project areas about which questions frequently arise. This is not a complete list, and is simply given to provide some basis for interpretation of the category descriptions.

Instruments:

The design and construction of a telescope, bubble chamber, laser, or other instrument would be Engineering if the design and construction were the primary purpose of the project. If a telescope were constructed, data gathered using the telescope, and an analysis presented, the project would be placed in Earth and Space Sciences.

Marine Biology:

Behavioral and Social Sciences (schooling of fish), Botany (marine algae), Zoology (sea urchins), or Environmental Sciences (plant and animal life of sea, river, pond).

Fossils:

Botany (prehistoric plants), Chemistry (chemical composition of fossil shells), Earth and Space Sciences (geological ages), and Zoology (prehistoric animals).

Rockets:

Chemistry (rocket fuels), Earth and Space Sciences (use of a rocket as a vehicle for meteorological instruments), Engineering (design of a rocket), or Physics (computing rocket trajectories). A project on the effects of rocket acceleration on mice would go in Medicine and Health.

Genetics:

Biochemistry (studies of DNA), Botany (hybridization), Microbiology, (genetics of bacteria), or Zoology (fruit flies).

Vitamins:

Biochemistry (how the body deals with vitamins), Chemistry (analysis), and Medicine and Health (effects of vitamin deficiencies).

Ecology—Environment—Pollution:

In a study of the eutrophication of lakes: Behavioral and Social Sciences (the human beings who caused the problem), Chemistry (the process of eutrophication), Botany (growth of algae), Engineering (water purification systems), Medicine and Health (health effects on human beings), Microbiology (effects on microorganisms), Zoology (the fish population), and Environmental Sciences (study of relations between organisms and polluted environment).

Pesticides:

Biochemistry (the mechanism of toxic effects), Botany (plant intake and concentration), Chemistry (composition of pesticides), Earth and Space Sciences (mechanisms of runoff), Medicine and Health (effects on human beings and animals).

Crystallography:

Chemistry (crystal composition), Mathematics (symmetry), and Physics (lattice structure).

Speech and Hearing:

Behavioral and Social Sciences (reading problems), Engineering (hearing aids), Medicine and Health (speech defects). Physics (sound), Zoology (structure of the ear).

Radioactivity:

Biochemistry, Botany, Medicine and Health and Zoology could all involve the use of tracers. Earth and Space Sciences or Physics could involve the measurement of radioactivity. Engineering could involve design and construction of detection instruments.

Space-related projects:

Note that many projects involving "space" do not go into Earth and Space Sciences. Botany (effects of zero G on plants), Medicine and Health (effects of G on human beings), Engineering (development of closed environmental system for space capsule).

Computers:

Computers will no longer be routinely assigned to mathematics. Instead, as a general rule computer-based projects should first be considered for assignment to the area of basic science on which the project focuses. As examples: if the computer is used to calculate rocket trajectories then it would be assigned to Physics, or if the computer is used to calculate estimates of heat generated from a specified inorganic chemical reaction then it should be entered in Chemistry, or if the computer is used as a teaching aid or to demonstrate "intelligent behavior" then it should be entered in Behavioral and Social Sciences.

Applications of this general rule will usually assign about half of the computer-based projects to one of the basic science categories. The balance will be placed through use of the following guidelines. If the project addresses computer hardware, firmware, or system software in terms of design, configuration, construction of the computer to perform mathematics or demonstrates the use of general application software (programs, algorithms, languages, graphics, etc.) then it should be placed in Mathematics. Any projects not yet assigned through use of the above guidelines should be placed in Mathematics.

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